



Customer-Focused Solutions

February 5, 2001

California Regional Water Quality Control Board
Los Angeles Region
320 West 4th Street, Suite 200
Los Angeles, California 90013

ATTN: MR. JIMMIE WOO

SITE: JALK FEE PROPERTY
10607 NORWALK BOULEVARD
SANTA FE SPRINGS, CALIFORNIA

RE: CLARIFICATION OF VAPOURT AND SESOIL MODEL
INPUT PARAMETERS

Dear Mr. Woo:

At the request of the California Regional Water Quality Control Board (CRWQCB), TRC Alton Geoscience (TRC) is providing clarification and supporting information regarding the input parameters used in the VapourT and SESOIL Models for the Jalk Fee property in Santa Fe Springs, California. This clarification and refinement process yields a concentration of tetrachloroethene (PCE) potentially introduced into the ground water beneath this site that is below the maximum contaminant level (MCL). Further, it is important to note that the conservative assumptions input into the models do not include biodegradation. Inclusion of this natural process, with its half-life ranging between 34¹ and 230 days², would reduce the concentrations estimated herein by orders of magnitude because a significant number of the PCE concentration data are from previous assessment and remediation efforts. Many of these data are several years old.

Groundwater Gradient

The groundwater gradient was recalculated from groundwater maps for the site from the Third Quarter 1994, First Quarter 1995, First Quarter 1997, Second Quarter 2000, Third Quarter 2000 and Fourth Quarter 2000. The calculations indicated the gradient ranged from 0.006 to 0.008 ft/ft between 1994 and 2000. This gradient differs from 0.06 ft/ft used in the models. The VapourT and SESOIL Models were revised accordingly. The groundwater maps are provided in Attachment 1.

Hydraulic Conductivity and Water Bearing Zone Thickness

Based on a review of site-specific borings logs, a sand horizon is consistently present below 40 to 45 feet below ground surface (bgs) and extends to approximately 106 bgs (Attachment 2). According to the boring logs reviewed, the sand horizon consists of fine to coarse sand with minor gravel and trace silt to a depth of approximately 65 fbg. Below 65 fbg, the sand grades into a medium to coarse sand with minor very coarse sand in the water-bearing zone. Based

¹ Davis, Andy and Roger L. Olsen. Predicting the Fate and Transport of Organic Compounds in Groundwater, Part 2, HMC, pages 18-37, July/August 1990.

² Roberts, P.V., J.E. Schreiner and G.D. Hopkins. Water Res., Volume 16, pages 1025-1035, 1982.

Clarification of VapourT and SESOIL Model Input Parameters
Jalk Fee Property, Santa Fe Springs, CA
February 5, 2001

on the boring log from Monitoring Well MW-5, it appears the saturated or mixing zone is approximately 35 feet thick. In addition, based on a review of Cross Section N-N' included in the California Department of Water Resources Bulletin 104 (Attachment 2), the saturated or mixing zone in the Exposition Aquifer is approximately 70 feet thick. For the purposes of the VapourT and Sesoil modeling, a conservative water bearing zone thickness of 10 feet (length of a typical well screen) was used. If the site specific (35 feet) or published (70 feet) water bearing zone thickness were used, the calculated input of PCE into groundwater would be even less.

Particle size analysis using ASTM D4464M completed on two samples from the sand horizon just above 60 fbg, (i.e., Borings HS-2 and HS-3 at 56 fbg) indicated the sand was fine to medium grained which correlates with the field logs completed for these borings. Based on the boring log review and particle size analysis, published hydraulic conductivity (K) values for a "clean sand" ranges from about 2×10^{-4} to 9×10^{-1} centimeters per second (cm/sec) (Freeze and Cherry, 1979). If this range is divided into three parts: one for fine, one for medium, and one for coarse, the line that separates the medium and coarse sand (the grain size observed at the Jalk Fee site in the water bearing zone), falls on about 6×10^{-2} cm/sec (Attachment 3).

Infiltration Rate

Infiltration of precipitation from the surface down 70 feet to ground water is an important process that transports PCE from the soil en route. The infiltration rate is calculated from the average precipitation of 15 inches per year³. This average precipitation is converted into units of meters per second (used in the VapourT model) as follows: 15 inches per year = 1.25 feet per year = 0.381 meters per year = 1.21E-8 meters per second equivalent vertical velocity or infiltration flux. The equivalent flux units are cubic meters of water per square meter of earth's surface per second.

This calculated infiltration rate is considered conservative because it assumes no runoff or evapotranspiration and an average annual rainfall that is 3.58 inches above the average annual rainfall data collected at a nearby meteorological station. In addition, the volume of water that is assumed to infiltrate through the vadose zone is ignored in the calculation of groundwater volume passing under the site, and hence its effect in diluting groundwater concentrations further (i.e., if the volume of infiltrate were included in the calculation of groundwater concentration, the predicted concentrations would be even lower).

³ Long-term (119 years) arithmetic mean rainfall at Los Angeles Civic Center = 14.99 inches (approximately 15 inches) (Los Angeles Times using National Weather Service data).

Clarification of VapourT and SESOIL Model Input Parameters
Jalk Fee Property, Santa Fe Springs, CA
February 5, 2001

Refined VapourT Modeling

The input parameters were rechecked and refined, including the values discussed above. Initial concentrations of PCE in the vapor phase in pore spaces in the four layers were used instead of total PCE concentrations as measured by laboratory analysis of soil samples. The calculation of these revised initial concentrations is shown in Table 1. The results of the axisymmetric and cartesian runs of VapourT are shown in Table 2 and the model runs are included in Attachment 4.

Revised Hydrocarbon Fate and Transport Modeling

The fate and transport of petroleum hydrocarbons was previously performed with Sesoil using naphthalene as a surrogate for the hydrocarbons (Alton Geoscience, 1998). The initial source concentration for naphthalene (2,700 micrograms per kilogram [$\mu\text{g}/\text{kg}$]) was based on the maximum concentration of naphthalene detected in soil samples analyzed using EPA Method 8310. The results of the 1998 Sesoil analysis indicate that naphthalene was not predicted to impact groundwater beneath the site at any time during a 200-year model run. The maximum vertical migration of naphthalene predicted by the Sesoil analysis was to a depth of approximately 59 feet below grade.

The database for the 1998 Sesoil model included some impacted soils that have since been removed in the excavation efforts conducted between October and November 2000. Additional sampling data were collected during this effort. The combined result of these activities indicated maximum naphthalene concentration was decreased to 1,700 $\mu\text{g}/\text{kg}$. For reference, the mean naphthalene concentration in soil based on all soil data from the site was approximately 70 $\mu\text{g}/\text{kg}$. The mean naphthalene concentration is considerably lower than the assumed concentration used in the Sesoil modeling performed in 1998. Since the maximum and mean concentrations of the naphthalene for the site are lower now than they were in 1998, TRC concludes that the previous modeling results represent a conservative estimate of the fate and transport potential of the hydrocarbons in-place at the Jalk Fee site. In addition, historical data would support this conclusion. The site has been an active oil field since the 1920's and groundwater monitoring data collected to date has indicated no impacts relating to the non-chlorinated hydrocarbons detected in previous assessment and confirmation soil samples.

Conclusions

Refined VapourT Modeling

The refined VapourT modeling indicates that the total contribution of PCE to groundwater from PCE impacted soils at the Jalk Fee property is less than the MCL.

Clarification of VapourT and SESOIL Model Input Parameters
Jalk Fee Property, Santa Fe Springs, CA
February 5, 2001

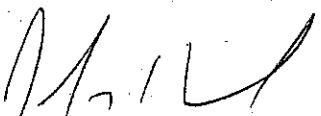
Revised Hydrocarbon Fate and Transport Modeling

A review of the revised naphthalene (hydrocarbon surrogate) database for the Jalk Fee site (i.e., revised downward to reflect the October and November 2000 removal of impacted soils from the Jalk Fee site and confirmation sampling also performed at that time) indicate a lower maximum and average naphthalene concentration exists now than what was used in the 1998 Sesoil analysis. Therefore, it can be concluded that the results of the 1998 Sesoil analysis that predicted no impact groundwater beneath the site at any time during a 200-year model run are still valid.

The results of the refined VapourT and Sesoil analyses predicted similar concentrations in groundwater and VapourT accounts for both the diffusive and advective components of migration within the vadose zone. Because the results of the refined VapourT and Sesoil modeling indicate that residual concentrations of PCE and crude oil in the soil do not pose a significant threat to groundwater underlying the site, TRC, on behalf of the Mobil Foundation (property owner), respectfully requests soil closure.

Please call me at 949-341-7449 or Buddy Hand at 713-656-9179 if you need any additional information or would like to discuss further.

Sincerely,



Jeff Hensel, RG, REA
Project Manager


FOR

Todd Stanford, REHS, REA
Principal Associate



Eric Walther, Ph.D.
Vice President

cc: Ms. Rueen-Fang Wang, California Regional Water Quality Control Board
Ms. Brenda Nelson, Santa Fe Springs Fire Department
Mr. F.E. Hand, ExxonMobil
Mr. Greg Chila

Attachments

TABLE 1
CALCULATION OF INITIAL PCE VAPOR CONCENTRATION FROM MEASURED TOTAL CONCENTRATION IN SOIL
JALK FEE PROPERTY

EQUATIONS	SOURCE OR RATIONALE
$Cv_{eq} (\text{mg/m}^3) = ((H * C_{soil} * BD) / (P_w + K_s * BD + H * P_a)) * CF_1$	
$Cv_{eq} (\text{atm}) = (Cv_{eq} (\text{mg/m}^3) * R * T) / (MW * CF_2)$	
$K_s = foc * K_{oc}$	Ideal Gas Law

SYMBOLS AND DESCRIPTIONS	UNITS	LAYER			SOURCE OR RATIONALE
		1 (Top)	2	3	
C_{soil} = Concentration of PCE in Soil	mg/kg	9.94E-01	9.20E-02	2.23E-01	2.20E-02 (From site data)
C_{soil} = Concentration of PCE in Soil	g/g soil	9.94E-07	9.20E-08	2.23E-07	2.20E-08 (Conversion applied)
H = Henry's Law Constant	units	0.546	0.546	0.546	0.546
BD = Bulk Density of Soil	g soil/cm ³ soil	1.52	1.49	1.65	1.42 (From SESOIL Model run)
P_w = Water-Filled Porosity of Soil	cm ³ water/cm ³ soil	0.09	0.09	0.09	0.09 (site specific; from SESOIL Model run)
foc = Fraction of Organic Carbon in Soil	g carbon/g soil	0.0093	0.0093	0.0093	0.0093 (Site specific)
K_{oc} = Carbon-Water Partition Coefficient of PCE	cm ³ water/g carbon (g soil)/(g/cm ³ water)	364	364	364	364 (Pankow, 1988)
P_a = Air-Filled Porosity of Soil	cm ³ air/cm ³ soil (mg/m ³)/(g/cm ³)	0.19	0.19	0.19	0.19 (by equation)
CF_1 = Correction Factor	mg/m ³	1.00E+09	1.00E+09	1.00E+09	1.00E+09 (site specific; from SESOIL Model run)
Cv_{eq} = Equilibrium Vapor Concentration ⁽¹⁾	mg/m ³	1.55E+02	1.43E+01	3.48E+01	3.41E+00 (by definition)
R = Universal gas law constant	atm m ³ /mol K	8.21E-05	8.21E-05	8.21E-05	8.21E-05 (by definition)
K = Temperature	K	2.91E+02	2.91E+02	2.91E+02	2.91E+02 64F, the long-term average temp. in Los Angeles
MW = Molecular Weight of PCE	g/g mol	1.6585E+02	1.6585E+02	1.6585E+02	1.6585E+02 Chemical specific
CF_2 = Conversion Factor	mg/g	1.00E+03	1.00E+03	1.00E+03	1.00E+03 (by definition)
Cv_{eq} = Equilibrium Vapor Concentration ⁽¹⁾	atm	2.22E-05	2.06E-06	5.00E-06	4.91E-07
Cv_{eq} = Equilibrium Vapor Concentration ⁽¹⁾	% of atm	2.22E-03	2.06E-04	5.00E-04	4.91E-05

1) Vapor Pressure at Saturation = 13.7 mm Hg or 0.018 atm. Therefore, Cv eq (atm) cannot exceed 0.018 atm = 1.8 % of atm = 125,000 mg/m³.
Davis, Andy and Roger L. Olsen. *Predicting the Fate and Transport of Organic Compounds in Groundwater*. Part 2, HMC, pages 18-37, July/August 1990.

TABLE 2
VAPOUR-T MODELING (1)
JALK FEE PROPERTY

PARAMETER	UNITS	RUN	
		AXISYMMETRIC	CARTESIAN ⁽²⁾
		Jalk9 ^(1B)	Jalk10xy ^(1B)
LENGTH OF MODEL RUN ⁽³⁾	days	10,884	7,040
PEAK PCE TRANSPORTED INTO GROUNDWATER ⁽⁴⁾	kg/12 hr time step	3.81E-05	7.5E-06
WIDTH OF PCE COLUMN ⁽⁵⁾	feet	69	122
	meters	21	37
GROUNDWATER FLOW BENEATH PCE COLUMN ^(6,7,8)	liters/ year	8.48E+06	1.49E+07
POTENTIAL PCE CONCENTRATION IN GROUNDWATER	ug/l	3.3	0.4

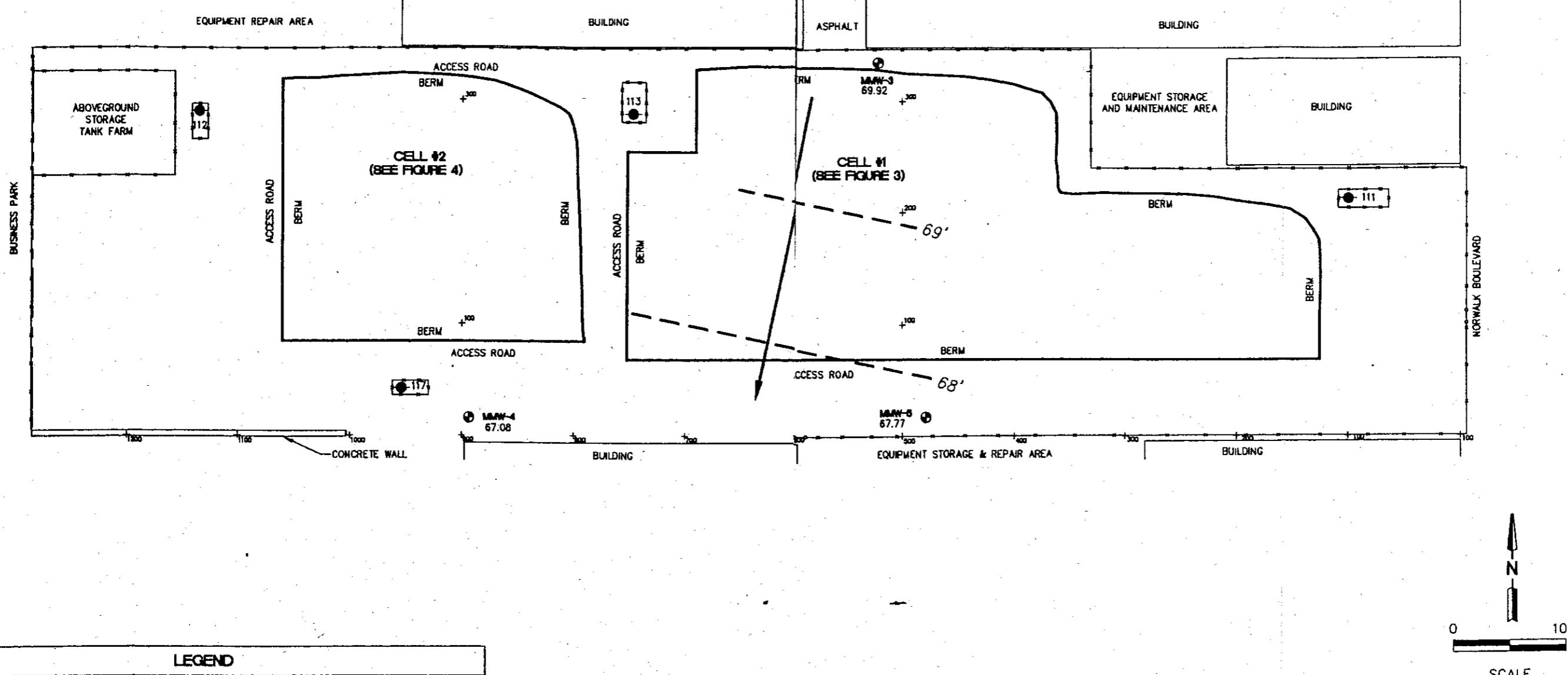
- 1) These runs differ from those contained in January 22, 2001 transmittal by: a) a revision of initial concentration from total in all phases of a soil sample to just that in the vapour phase in the soil pores (in percent of an atmosphere);
- b) refinement of K, dh/dl, H, k, T, and foc.
- 2) Mass transported into groundwater from the Vapour-T cartesian run is multiplied by 2 for left-right mirror-image symmetry of grid, and by 37 for number of meter "slices" of side length "into the paper" for simulation.
- 3) VapourT runs until change in outputs between time steps stabilize (i.e., become le
- 4) Amount of PCE transported into ground water stays at zero until first PCE reaches 70 ft bgs, then increases to a maximum, which is used below.
- 5) Width is transverse or perpendicular to ground water flow direction.
- 6) Hydraulic conductivity of groundwater used in SESOIL and V-LEACH (cm/sec) = 6E-02
- 7) Hydraulic gradient (head) of groundwater used in SESOIL (-) = 0.007
- 8) Thickness of groundwater for mixing (well screen length in feet) = 10

(2/1/01;10:54 AM)

Table1_R2.xls;Table 2 Brief

ATTACHMENT 1

3RD QUARTER 1994



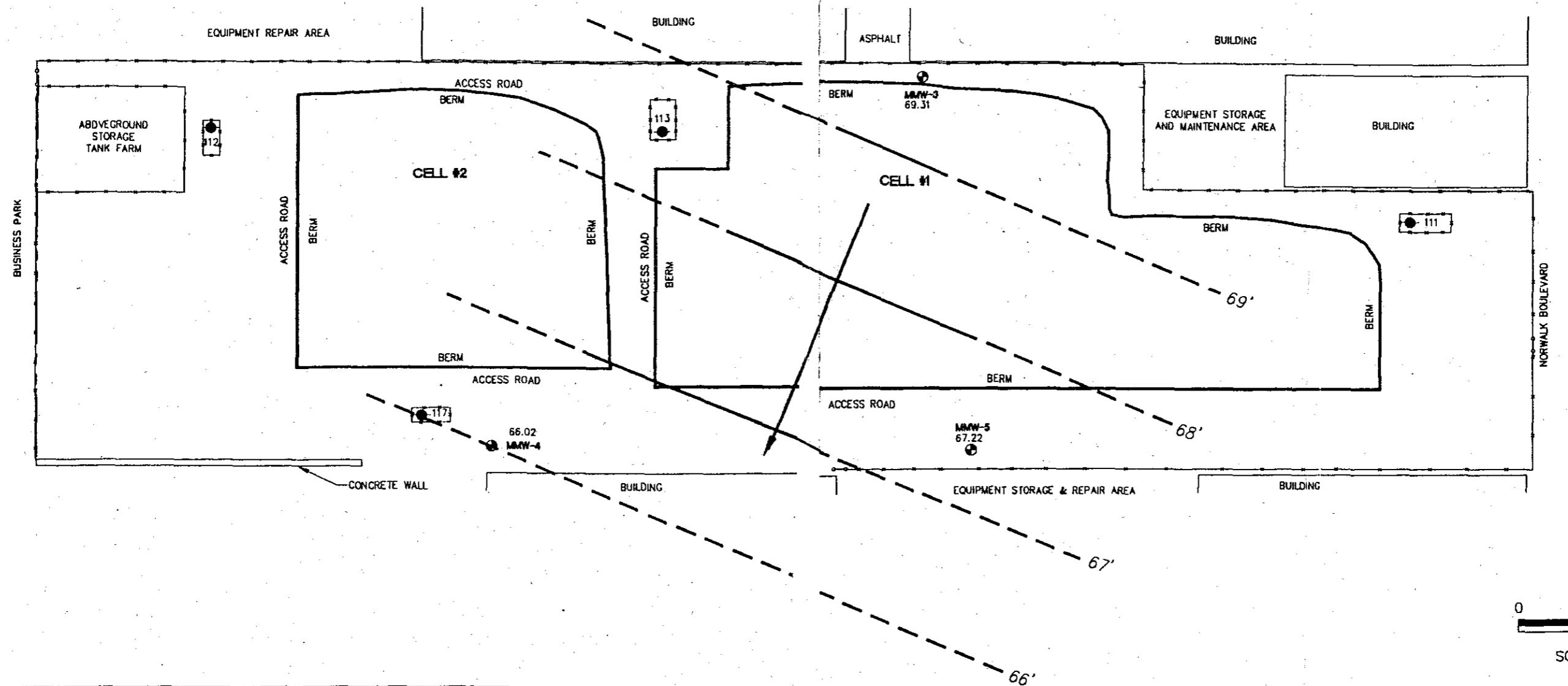
LEGEND

- APPROXIMATE AREA OF BIOREMEDIAL CELL (4.37 ACRES)
- MMW-4 67.08 GROUNDWATER MONITOR WELL LOCATION W/GROUNDWATER ELEVATION
- GROUNDWATER CONTOUR
- GROUNDWATER FLOW DIRECTION
- NOTES: SITE MAP MODIFIED FROM LEVINE-FRICKE (1991c). AREA ESTIMATIONS CONCERNING ACTIVE OIL WELLS AND EXISTING TANK FARM ARE BASED ON VISUAL OBSERVATIONS FROM LEVINE-FRICKE (1991c).
- 117 OPERATIONAL OIL WELL
- 100' SURVEYED MEASURED INTERVALS (100 FOOT) CHAIN LINK FENCE
- GATE

McGraw-Hill

FIGURE 5
GROUNDWATER ELEVATION
COUNTOURS
MOBIL JAKK FEE PROPERTY
10807 NORWALK BOULEVARD
SANTA FE SPRINGS, CA

MADE BY	DATE	UNITS OR DIMENSIONS
KAR/HK	10/19/94	
CHANGED BY	DATE	
APPROVED BY	DATE	
RECD.	10/20/94	
SCALE	100'	DRAWING NUMBER
		C9410007



LEGEND

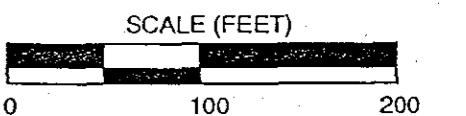
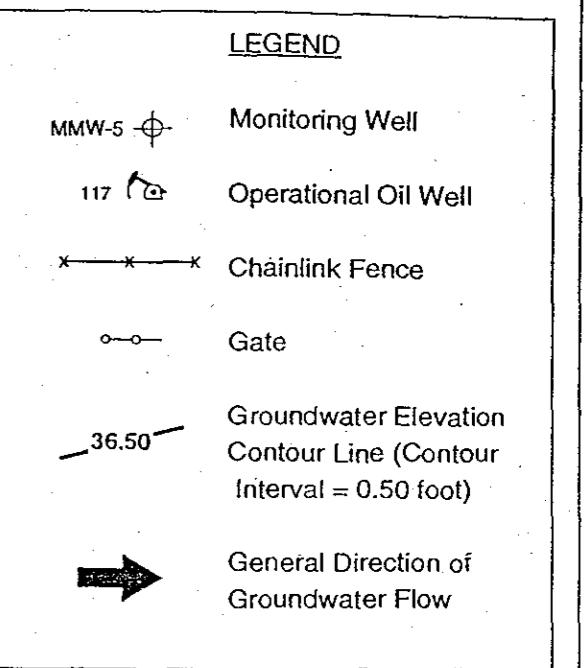
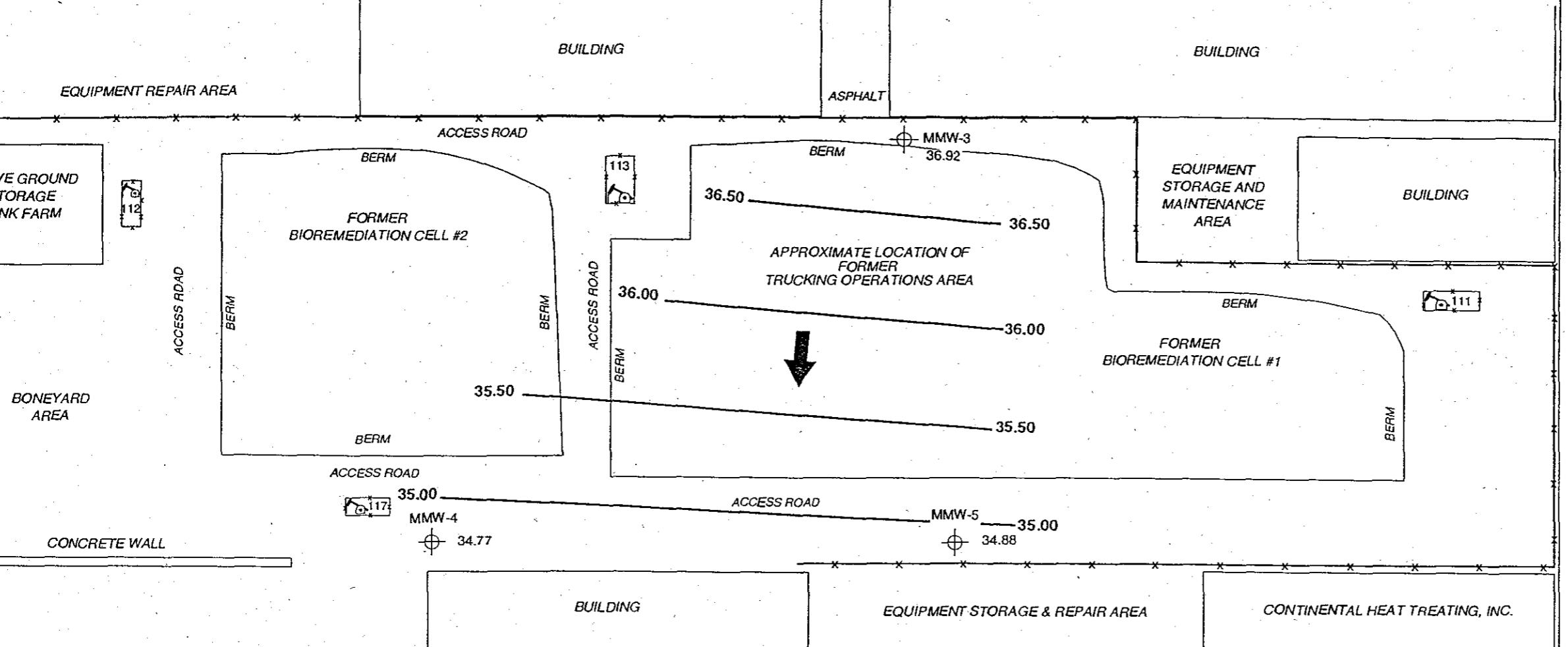
- APPROXIMATE AREA OF BIOREMEDIAL CELL (4.37 ACRES)
- MW-4 GROUNDWATER MONITOR WELL LOCATION
66.02 W/GROUNDWATER ELEVATION
- GROUNDRATE CONTOUR
- GROUNDRATE FLOW DIRECTION
- NOTES: SITE MAP MODIFIED FROM LEVINE-FRICKE (1991c). AREA ESTIMATIONS CONCERNING ACTIVE OIL WELLS AND EXISTING TANK FARM ARE BASED ON VISUAL OBSERVATIONS FROM LEVINE-FRICKE (1991c).
- 117 OPERATIONAL OIL WELL
- CHAIN LINK FENCE
- GATE

Mciarco Hart
16755 VON KARMAN AVENUE, IRVINE, CA 92714
TEL. (714)756-2667 FAX (714) 756-8460

FIGURE 3
GROUNDWATER ELEVATION CONTOURS
FIRST QUARTER 1995
(JANUARY-MARCH)
MOBIL JALK FEE
106D7 NORWALK BOULEVARD
SANTA FE SPRINGS, CA

DRAWN BY: E. Muresan	DATE: 3-28-95	PROJECT NAME: MOBIL JALK FEE
CHECKED BY: S. English	DATE: 3-28-95	PROJECT NUMBER: 03.00601266.000
APPROVED BY: T. Bubier	DATE: 3-28-95	REVISION DATE: 3-28-95

N

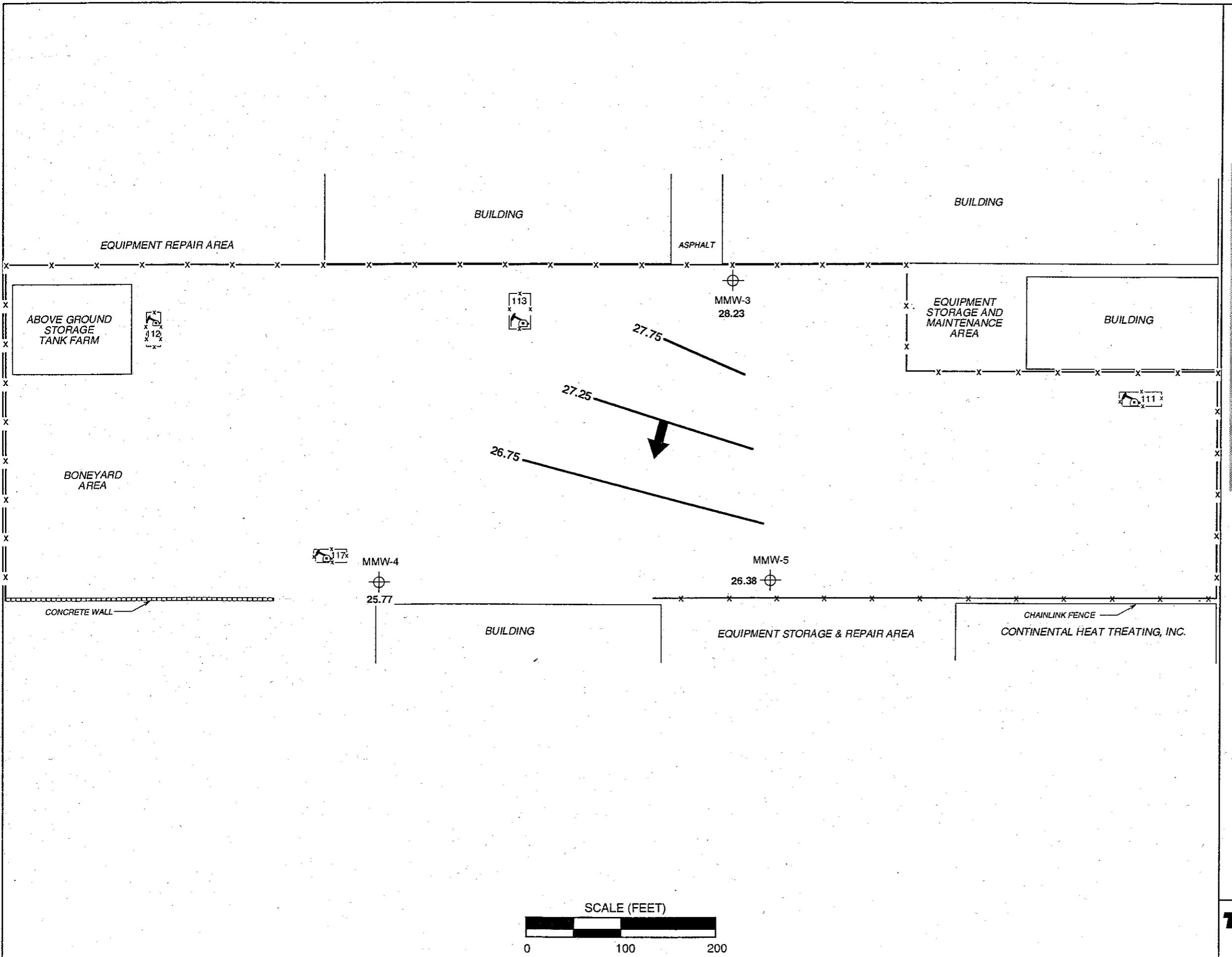


NOTE:

Elevations are calculated using survey data to an arbitrary benchmark of 100 feet.

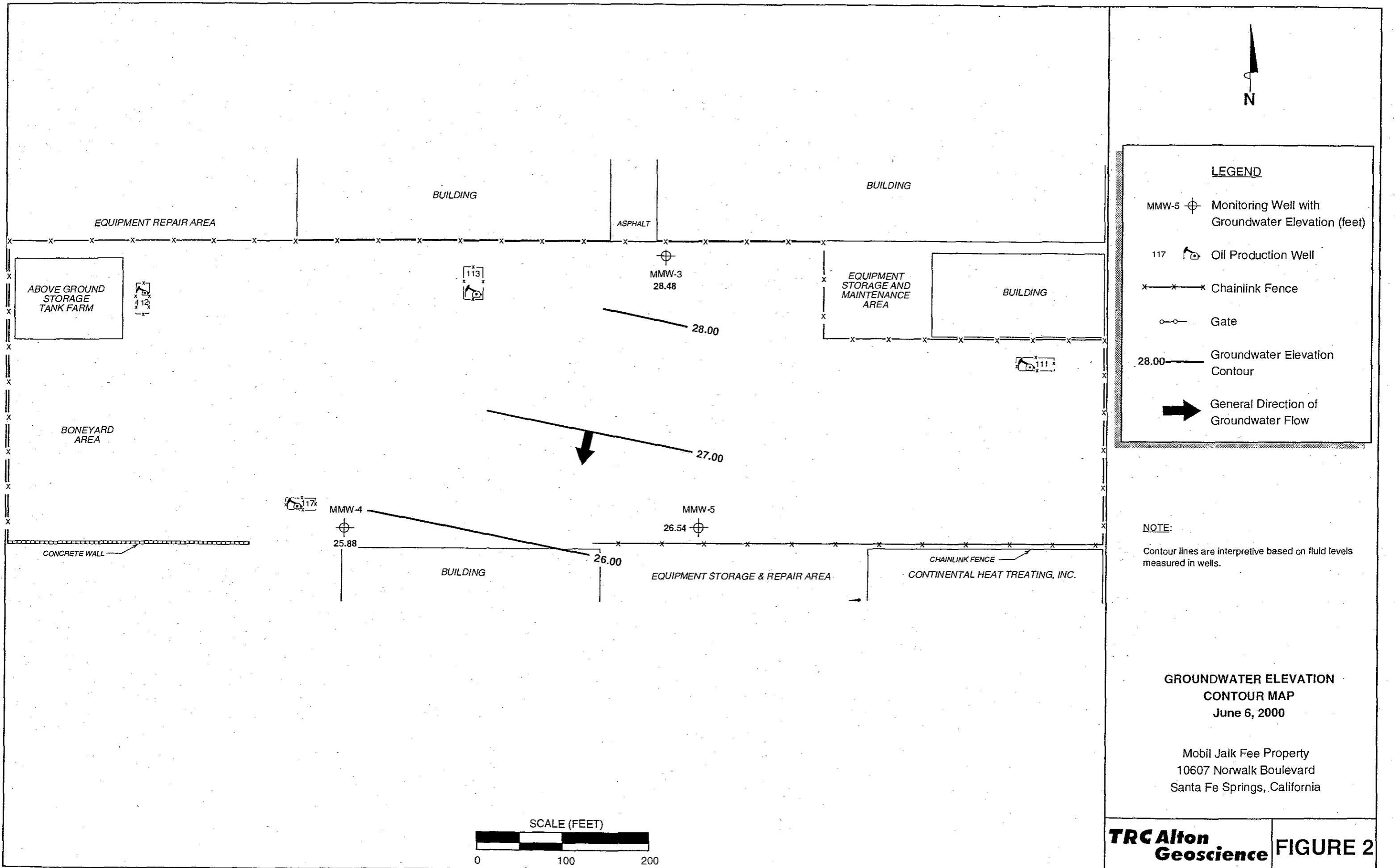
GROUNDWATER ELEVATION
CONTOUR MAP
March 26, 1997

Mobil Jalk Fee Property
10607 Norwalk Boulevard
Santa Fe Springs, California

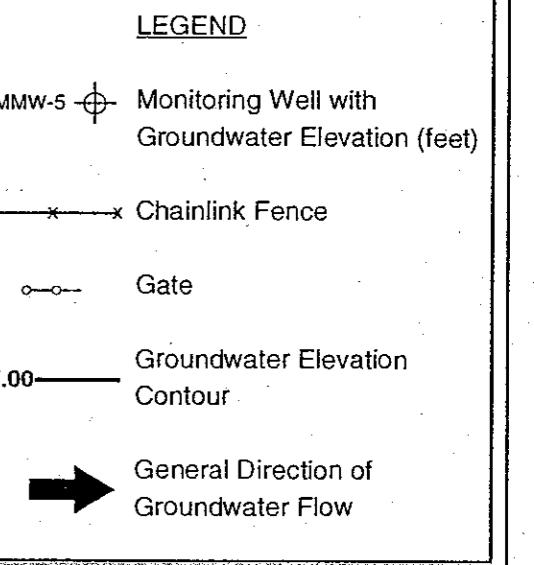
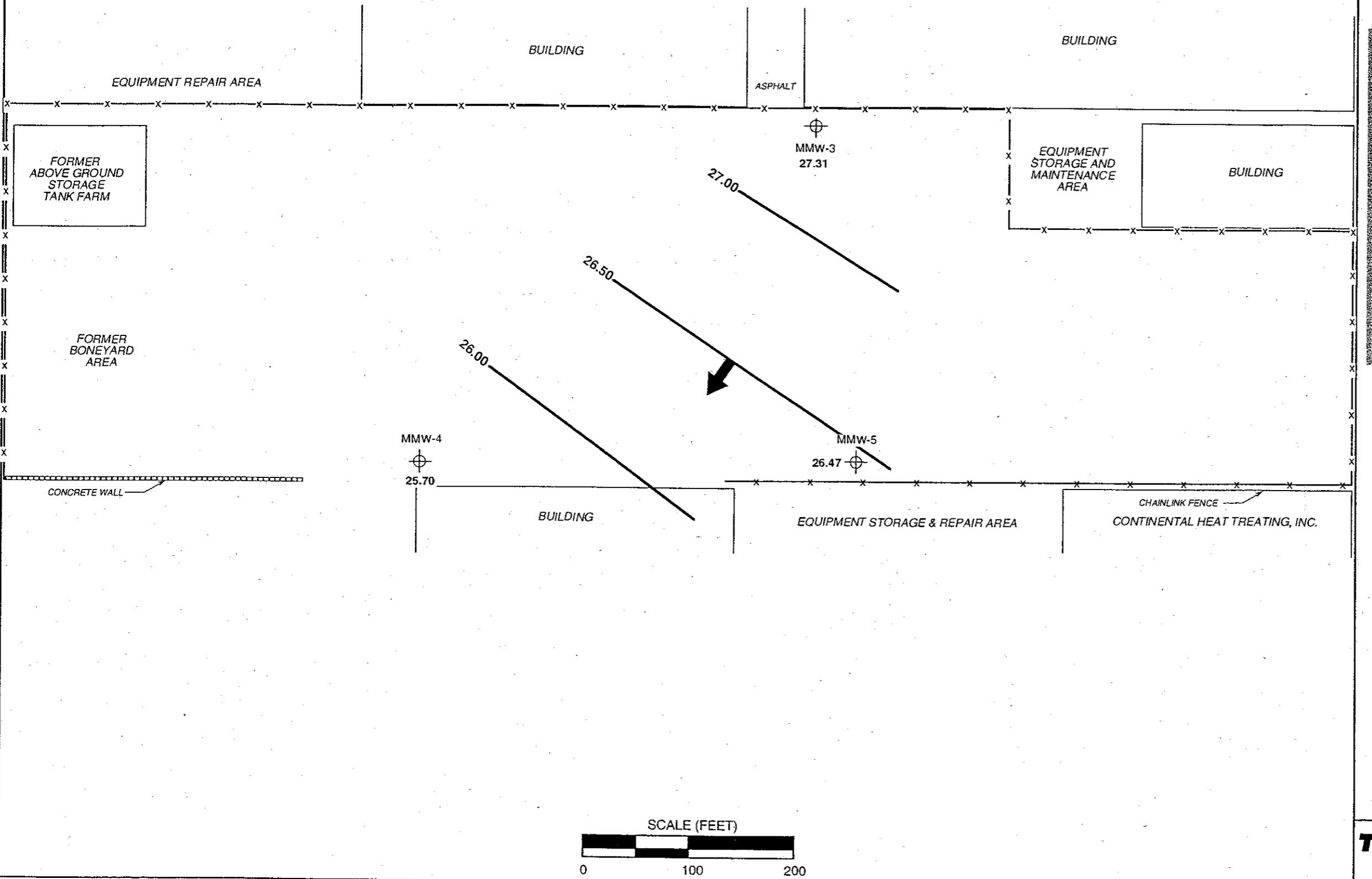


TRC Alton Geoscience | **FIGURE 2**

N



N



NOTE:
Contour lines are interpretive based on fluid levels measured in wells. Elevations are calculated using survey data to an arbitrary benchmark of 100 feet.

**GROUNDWATER ELEVATION
CONTOUR MAP**
September 15, 2000

Mobil Jalk Fee Property
10607 Norwalk Boulevard
Santa Fe Springs, California

**TRC Alton
Geoscience** **FIGURE 2**

ATTACHMENT 2

SB/MW#: MB-2
 #D_ 15594-96
 Page 1 of 2
 Sampler: T. Overturf

SOIL DRILLING LOG

PROJECT Mobil Jalk Fee LOCATION 10607 Norwalk Blvd., Santa Fe Springs
 ELEVATION MONITORING DEVICE PID
 SAMPLING DATE(S) 12-29-95 START 9:15 AM FINISH 11:00 AM
 SAMPLING METHOD CA MOD SPLIT SPOON SUBCONTRACTOR & EQUIPMENT BC2 Environmental
 MEMO Hand Augered 1st 5 feet.

Depth Below Surface (ft.)	Penetration Results		Sample Depth Interval (ft.)	Sample ID #	Hnu Reading (PPM)	Soil Description Color, Texture, Moisture, Etc.	Unfired Class.	Graphic Log	Sample Depth	Borehole Abandonment/ Well Construction Details
	Blows 6'-6"-6"	BPF								
0					0.0	Dirt surface.				
5	15-21-30		5.0 6.5	-	27	@5' Sat: (0,0,98,2); dark yellowish brown (7.5YR 3/4); non-plastic; medium dense; damp.	ML			8" Diameter Borehole
10	17-20-23		10.0 11.5	-	132	@10' Very dark grayish brown (2.5Y 3/2).				Backfilled with Hydrated Bentonite Chips
15	14-19-24		15.0 16.5	-	1169 996	@15' Strong solvent odor; 1 1/2 thick black layer at 16.0' looks like solvent; 10% clay content.				
20	15-23-25		20.0 21.5	-	140	@20' Sat: (0,0,100,0); olive gray (5Y 5/2).				
25	17-22-25		25.0 26.5	MB-2-25	170	@25' Light olive brown (2.5Y 5/3); micaceous.				
30						Continued Next Page				

SB/MW#: **MB-2**
#D- **15594-96**
Page **2** of **2**
Sampler: **T. Overturf**

SOIL DRILLING LOG

PROJECT Mobil Jack Fee LOCATION 10607 Norwalk Blvd., Santa Fe Springs

PROJECT NO.: 23-0134-50

DATE DRILLED: July 13, 1997

LOCATION: Mobil Jalk Fee

LOGGED BY: C. Cullum

10607 Norwalk Boulevard

APPROVED BY: K. Keenan, RG

Santa Fe Springs, California

DRILLING CO.: West Hazmat Drilling-CME-75

BLOWS PER 6 INCHES	PID (ppm)	TPH-G (ppm)	SAMPLE	DEPTH (feet below grade)	DESCRIPTION	USCS	SYMBOL	WELL CONSTRUCTION DETAIL											
								0	5	10	15	20	25	30	35	40			
12/17/23	2,000			0															
				5	SILTY SAND: moderate yellowish brown, medium dense, moist, fine-grained sand, trace clay.		SM												
10/12/13	2,000			10															
				15	SANDY SILT: moderate brown, very stiff, slightly moist, fine-grained sand.		ML												
15/19/22	31			20	CLAY: pale yellowish brown, very stiff, slightly moist.		CL												
12/16/16	37			25	SILT: moderate brown, very stiff, slightly moist, very fine-grained sand.		ML												
19/24/29	83			30	SANDY SILT: moderate brown, hard, slightly moist, very fine-grained.		ML												
25/50	45			35	SILTY SAND: dark yellowish brown, medium dense, slightly moist, fine-grained sand.		SM												
16/22/28	10			40															

Bentonite Grout ←

PROJECT NO.: 23-0134-50

LOCATION: Mobil Jalk Fee

10607 Norwalk Boulevard

Santa Fe Springs, California

DATE DRILLED: July 13, 1997

LOGGED BY: C. Cullum

APPROVED BY: K. Keenan, RG

DRILLING CO.: West Hazmat Drilling-CME-75

BLOWS PER 6 INCHES	PID (ppm)	TPH-G (ppm)	SAMPLE	DEPTH (feet below grade)	DRILLING METHOD: 6-inch Hollow-Stem Auger	USCS	SYMBOL	WELL CONSTRUCTION DETAIL							
					SAMPLER TYPE: California Modified Split Spoon										
TOTAL DEPTH: 61.5 feet DEPTH TO WATER: NA															
DESCRIPTION															
25/50	5			40	SILTY SAND: dark yellowish brown, medium dense, slightly moist, fine-grained sand.	SM		40							
28/50	28			45	SAND: moderate yellow, medium dense, moist, fine-grained.	SP		45							
26/48	13			50	Fine- to coarse-grained, with gravel.			50							
60	5			55	Trace clay.			55							
18/24				60	Light olive gray, fine- to medium-grained.			60							
				65				65							
				70				70							
				75				75							
				80				80							

PROJECT NO.: 23-0134-50

LOCATION: Mobil Jalk Fee

10607 Norwalk Boulevard

Santa Fe Springs, California

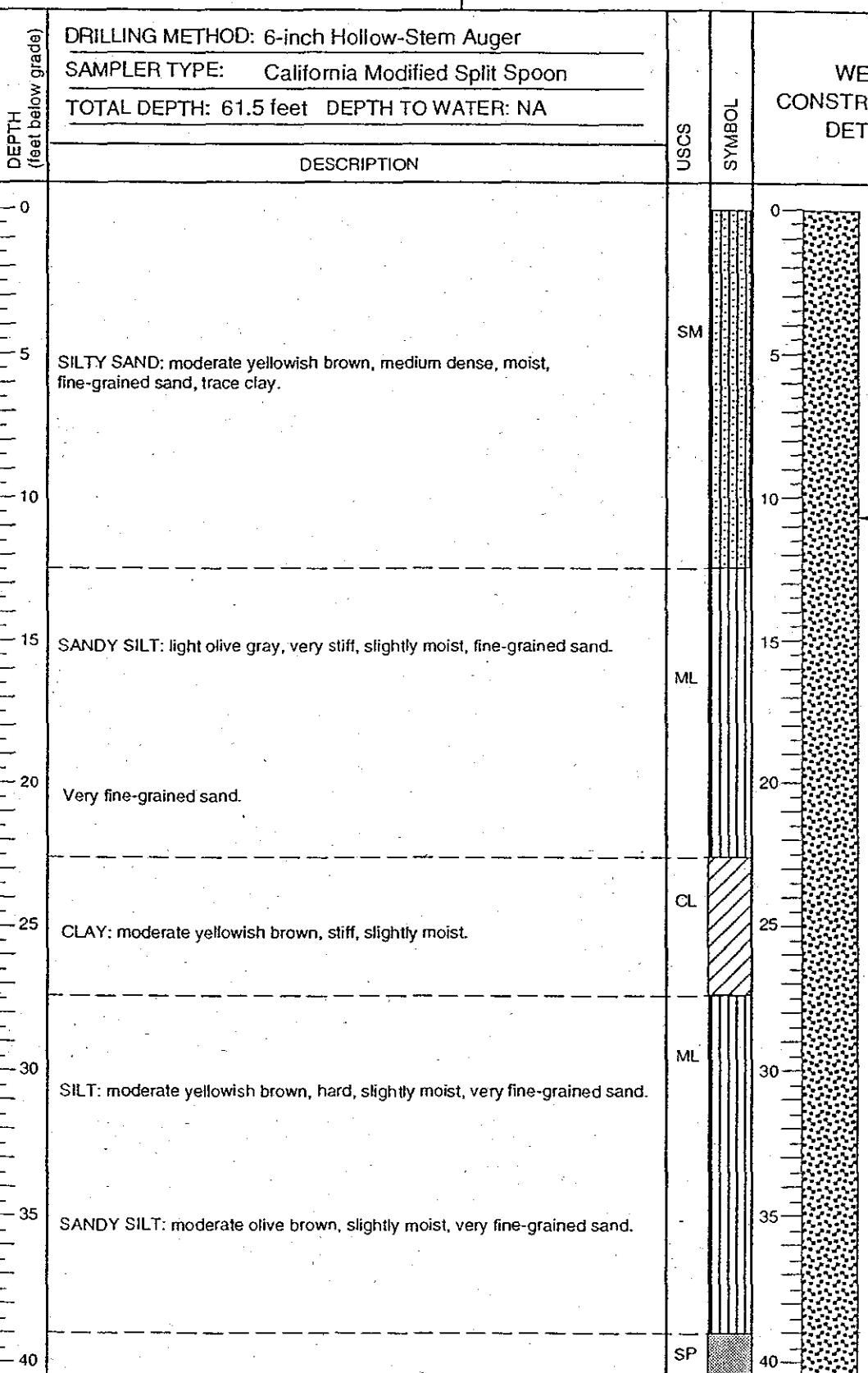
DATE DRILLED: July 12, 1997

LOGGED BY: C. Cullum

APPROVED BY: K. Keenan, RG

DRILLING CO.: West Hazmat Drilling-CME-75

BLOWS PER 6 INCHES	PID (ppm)	TPH-G (ppm)	SAMPLE	DEPTH (feet below grade)	DRILLING METHOD: 6-inch Hollow-Stem Auger	USCS	SYMBOL	WELL CONSTRUCTION DETAIL
					SAMPLER TYPE: California Modified Split Spoon			
					TOTAL DEPTH: 61.5 feet DEPTH TO WATER: NA			
					DESCRIPTION			
12/14/18	2,000			0				
				5	SILTY SAND: moderate yellowish brown, medium dense, moist, fine-grained sand, trace clay.	SM		
10/14/17	350			10				
				15				
13/15/18	1,500			15	SANDY SILT: light olive gray, very stiff, slightly moist, fine-grained sand.	ML		
16/17/25	2,000			20	Very fine-grained sand.			
12/17/19	750			25	CLAY: moderate yellowish brown, stiff, slightly moist.	CL		
25/30	600			30				
				35	SILT: moderate yellowish brown, hard, slightly moist, very fine-grained sand.	ML		
15/21/28	2,000			35	SANDY SILT: moderate olive brown, slightly moist, very fine-grained sand.			
				40		SP		



PROJECT NO.: 23-0134-50

LOCATION: Mobil Jalk Fee

10607 Norwalk Boulevard

Santa Fe Springs, California

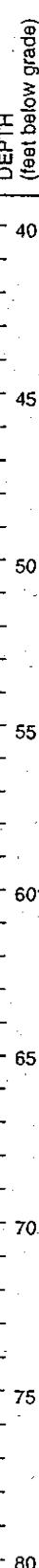
DATE DRILLED: July 12, 1997

LOGGED BY: C. Cullum

APPROVED BY: K. Keenan, RG

DRILLING CO.: West Hazmat Drilling-CME-75

BLOWS PER 6 INCHES	P/D (ppm)	TPH-G (ppm)	SAMPLE	DEPTH (feet below grade)	DRILLING METHOD: 6-inch Hollow-Stem Auger SAMPLER TYPE: California Modified Split Spoon TOTAL DEPTH: 61.5 feet DEPTH TO WATER: NA	USCS	SYMBOL	WELL CONSTRUCTION DETAIL	
								DESCRIPTION	
14/16/24	1,600			40	SAND: grayish olive, medium dense, slightly moist, fine-grained sand, some silt and gravel.	SP			
10/13/15	1,900			45	Fine- to medium-grained.				
12/17/21	1,000			50					
25/50	250			55	Fine- to coarse-grained.				
14/16/18	2,000			60					
				65					
				70					
				75					
				80					



PROJECT NO.: 23-0134-50

DATE DRILLED: July 13, 1997

LOCATION: Mobil Jalk Fee

LOGGED BY: C. Cullum

10607 Norwalk Boulevard

APPROVED BY: K. Keenan, RG

Santa Fe Springs, California

DRILLING CO.: West Hazmat Drilling-CME-75

BLOWS PER 6 INCHES	PID (ppm)	TPH-G (ppm)	SAMPLE	DEPTH (feet below grade)	DRILLING METHOD: 6-inch Hollow-Stem Auger		USCS	SYMBOL	WELL CONSTRUCTION DETAIL		
					SAMPLER TYPE: California Modified Split Spoon						
TOTAL DEPTH: 61.5 feet DEPTH TO WATER: NA											
					DESCRIPTION						
5/7/9	2,000			0	SILTY SAND: olive gray, loose, slightly moist, fine-grained sand.		SM		0		
9/17/20	2,000			5	Medium dense.				5		
14/20/24	1,500			10	SANDY SILT: olive gray, very stiff, slightly moist, fine-grained sand.		ML		10		
17/21/27	830			15	CLAY: pale olive, very stiff, slightly moist, very fine-grained sand.		CL		15		
16/21/24	900			20	SILT: moderate yellowish brown, very stiff, slightly moist, very fine-grained sand.				20		
18/24/32	850			25			ML		25		
19/26/26	2,000			30					30		
				35	SANDY SILT: moderate yellowish brown, very stiff, slightly moist, very fine-grained sand.				35		
				40			SP		40		

PROJECT NO.: 23-0134-50

DATE DRILLED: July 13, 1997

LOCATION: Mobil Jalk Fee

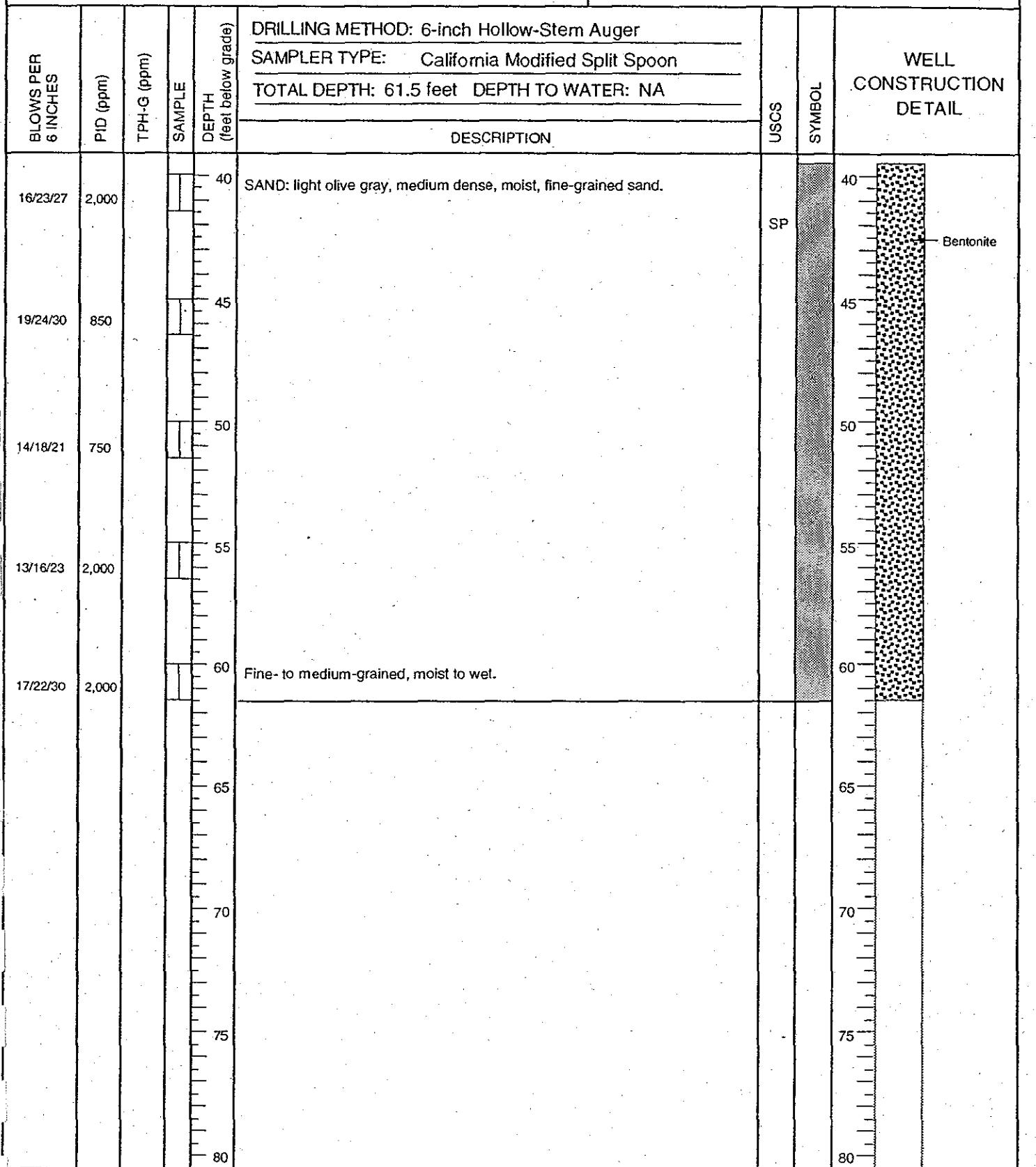
LOGGED BY: C. Cullum

10607 Norwalk Boulevard

APPROVED BY: K. Keenan, RG

Santa Fe Springs, California

DRILLING CO.: West Hazmat Drilling-CME-75



PROJECT NO.: 23-0134-50

DATE DRILLED: July 12, 1997

LOCATION: Mobil Jalk Fee

LOGGED BY: C. Cullum

10607 Norwalk Boulevard

APPROVED BY: K. Keenan, RG

Santa Fe Springs, California

DRILLING CO.: West Hazmat Drilling-CME-75

BLOWS PER 6 INCHES	PID (ppm)	TPH-G (ppm)	SAMPLE	DEPTH (feet below grade)	DRILLING METHOD: 6-inch Hollow-Stem Auger			WELL CONSTRUCTION DETAIL
					SAMPLER TYPE:	California Modified Split Spoon	TOTAL DEPTH: 61.5 feet DEPTH TO WATER: NA	
					DESCRIPTION		USCS	SYMBOL
7/10/25	2,000			0				
7/10/25	2,000			5	SILTY SAND: moderate brown, medium dense, slightly moist, fine-grained sand, trace clay.		SM	
10/17/26	2,000			10	Grayish olive green.			
12/16/23	2,000			15	SANDY SILT: olive gray, very stiff, slightly moist, fine-grained sand.		ML	
17/22/26	2,000			20	CLAY: dusky yellow, very stiff, slightly moist, very fine-grained sand.		CL	
14/18/27	2,000			25	SILT: moderate yellowish brown, very stiff, slightly moist, very fine-grained sand.			
16/21/30	2,000			30			ML	
24/50	2,000			35	SANDY SILT: light olive gray, hard, slightly moist, very fine-grained sand.			
				40			SM	
LOG OF EXPLORATORY BORING					HS-4 PAGE 1 OF 2			

PROJECT NO.: 23-0134-50

LOCATION: Mobil Jalk Fee

10607 Norwalk Boulevard

Santa Fe Springs, California

DATE DRILLED: July 12, 1997

LOGGED BY: C. Cullum

APPROVED BY: K. Keenan, RG

DRILLING CO.: West Hazmat Drilling-CME-75

BLOWS PER 6 INCHES	PID (ppm)	TPH-G (ppm)	SAMPLE	DEPTH (feet below grade)	DRILLING METHOD: 6-inch Hollow-Stem Auger		USCS	SYMBOL	WELL CONSTRUCTION DETAIL
					DESCRIPTION				
17/22/31	2,000			40	SILTY SAND: grayish olive green, medium dense, moist, very fine-grained sand.		SM		40
7/7/20	2,000			45	SAND: light olive gray, medium dense, moist, very fine-grained.		SP		45
11/13/14	2,000			50	CLAY: moderate yellowish brown, stiff, slightly moist, some silt.		CL		50
20/34/37	2,000			55	SILTY SAND: light olive gray, dense, moist, very fine-grained sand.		SM		55
25/50	2,000			60	Dusky yellow, very fine-grained sand.		SP		60
				65	SAND: light olive gray, moist to wet, fine- to medium-grained.				65
				70					70
				75					75
				80					80

SB/MW#: MW-3

#D- 19265-69

Page 1 of 4

Sampler: E. Ferguson

SOIL DRILLING LOG

PROJECT OFRP LOCATION Santa Fe Springs, CA
 ELEVATION ~150' above MSL MONITORING DEVICE QVM
 SAMPLING DATE(S) 1-7-8-94 START 1:00 PM - 3:00 PM FINISH 8:00 AM - 5:00 PM
 SAMPLING METHOD CA MOD SPLIT SPOON SUBCONTRACTOR & EQUIPMENT Gregg Drilling - B-61
 MEMO 6.5" O.D. Hollow Stem Augers were used to sample the borehole. (2" diameter x 6' length brass tubes). 10"
 O.D. Hollow Stem Augers were used to construct the wells. Continuous sampling began at 60'.

Depth Below Surface (ft.)	Penetration Results			Sample ID #	Hnu Reading (ppm)	Soil Description Color, Texture, Moisture, Etc.	Unified Class.	Graphic Log	Sample Depth	Borehole Abandonment/ Well Construction Details		
	Blows 6'-6"-6"	BPF	Sampler Depth Interval (ft.)									
0.0						Silt: (0,0,100,0); brown (7.5YR 5/3); non-plasticity; loose, dry.	ML			Locking PVC Cap Concrete		Traffic Rated Well Box
5	24-35-36	71	5.0 6.5	76512	0							
10	18-22-26	48	10.0 11.5	76513	0	10.0 Medium sand: (0,100,0,0); dark yellowish brown (10YR 4/4); non-plasticity; (100% medium sand); subrounded; poorly graded; loose; damp.	SP			4" O.D. PVC Blank Casing		10" Diameter Borehole
15	14-18-24	42	15.0 16.5	76514	0	15.0 Fine sand: (0,100,0,0); olive gray (5Y 5/2); non-plasticity; (100% fine sand); rounded; poorly graded; loose; damp.	SM					
20	9-11-15	26	20.0 21.5		0	20.0 Silt: (0,0,100,0); light olive brown (2.5Y 5/3); non-plasticity; loose; damp.	ML			Bentonite Chips		
25												
30												

Continued Next Page

SB/MW#: MW-3
 #D- 19265-69
 Page 2 of 4
 Sampler: E. Ferguson

SOIL DRILLING LOG

PROJECT		OFRP		LOCATION		Santa Fe Springs, CA					
Depth Below Surface (ft.)	Penetration Results		Sampler Interval (ft.)	Sample ID #	Hmu Reading (PPM)	Soil Description Color, Texture, Moisture, Etc.		Unified Class.	Graphic Log	Sample Depth	Borehole Abandonment/ Well Construction Details
	Blows 6'-6"-6"	BPF									
35	9-18-20	38	30.0 31.5		5	@30' Brown (10YR 5/3).		ML			4" O.D. PVC Blank Casing
40	10-20-28	48	40.0 41.5		1	@40' Yellowish brown (10YR 5/4).					10" Diameter Borehole
45											Bentonite Chips
50	16-19-25	44	50.0 51.5		14	50.0	Coarse sand: (0,100,0,0); greenish gray (5GY 6/1); non-plasticity; (60% coarse, 40% medium sand); angular; well graded; loose; damp.	SW			
55											
60	27-35-50 for 6"	100	60.0 61.5		27	60.0	Medium sand: (0,100,0,0); gray (5Y 6/1); non-plasticity; (100% medium sand); angular; poorly graded; loose; damp.	SP			Bentonite Pellets
65											

Continued Next Page

SB/MW#: **MW-3**
#D- **19265-69**
Page **3** of **4**
Sampler: **E. Ferguson**

SOIL DRILLING LOG

PROJECT _____ **QFRP** _____ **LOCATION** _____ **Santa Fe Springs, CA**

Continued Next Page

SB/MW#: MW-3
#D- 19265-69
Page 4 of 4
Sampler: E. Ferguson

SOIL DRILLING LOG

PROJECT _____ **OFRP** _____ **LOCATION** _____ **Santa Fe Springs, CA**

SB/MW#: MW-4

#D- 19260-64

Page 1 of 4

Sampler: S. English

SOIL DRILLING LOG

PROJECT QFRP LOCATION Santa Fe Springs, CA
 ELEVATION ~ 150' above MSL MONITORING DEVICE OVM
 SAMPLING DATE(S) 1-6/7-94 START 1:00 PM - 5:00 PM FINISH 7:00 AM - 12:00 PM
 SAMPLING METHOD CA MOD SPLIT SPOON SUBCONTRACTOR & EQUIPMENT Gregg Drilling - B-61
 MEMO 6.5" O.D. Hollow Stem Augers were used to sample the borehole. (2" diameter x 6" length brass tubes). 10"
 O.D. Hollow Stem Augers were used to construct the wells. * Continuous sampling began at 60".

Depth Below Surface (ft.)	Penetration Results			Soil Description Color, Texture, Moisture, Etc.	Unified Class.	Graphic Log	Sample Depth	Borehole Abandonment/ Well Construction Details		
	Blows 6"-6"-6"	BPF	Sampler Depth Interval (ft.)							
0.0				Silt: (0,20,80,0); olive gray (5Y 4/2); low plasticity; (100% very fine sand); subangular; poorly graded; stiff, dry.	ML			Locking PVC Cap Concrete		Traffic Rated Well Box
5	9-15-21	36	5.0 6.5	76509 24				4" O.D. PVC Blank Casing		
10	15-23-25	48	10.0 11.5	76510 12		@10' Olive gray (5Y 5/2).				10" Diameter Borehole
15	11-12-20	32	15.0 16.5	76511 40		@15' Gray (5Y 6/1).				
20	17-30-43	73	20.0 21.5		34	@20' Greenish gray (5GY 6/1).		Bentonite Chips		
25										
30				30.0						

Continued Next Page

SB/MW#: MW-4
#D- 19260-64
Page 2 of 4
Sampler: S. English

SOIL DRILLING LOG

PROJECT		OFRP		LOCATION		Santa Fe Springs, CA				
Depth Below Surface (ft.)	Penetration Results		Sampler ID #	Hnu Reading (ppm)	Soil Description Color, Texture, Moisture, Etc.		Unified Class.	Graphic Log	Sample Depth	Borehole Abandonment/ Well Construction Details
	Blows 6"-6"-6"	BPF			Interval (ft.)					
24	24-40-50 for 3"	100	30.0	55	31.5	Medium sand: (0,100,0,0); light olive gray (5Y 6/2); non-plasticity; (10% very coarse, 20% coarse, 70% medium sand); loose; angular-subangular; well graded; loose; dry.	SW			
35										
40	45-50 for 6"	100	40.0	43	41.5	@40' Gray (5Y 6/1).				
45										
50	27-24-14	38	50.0	74	51.5	50.0	Very fine sand: (0,70,30,0); olive gray (5Y 5/2); non-plasticity; (100% very fine sand); rounded; poorly graded; loose; damp.	SM		
55										
60	20-30-50 for 5"	100	60.0	34	61.5	60.0	Very fine sand: (0,100,0,0); dark gray (5GY 4/1); non-plasticity; (10% medium, 30% fine, 60% very fine sand); subangular; poorly	SM		
65										

Continued Next Page

SB/MW#: MW-4
#D- 19260-64
Page 3 of 4
Sampler: S. English

SOIL DRILLING LOG

PROJECT OFRP LOCATION Santa Fe Springs, CA

Depth Below Surface (ft.)	Penetration Results		Sample Interval (ft.)	Sample ID #	Hm Reading (ppm)	Soil Description Color, Texture, Moisture, Etc.	Unified Class.	Graphic Log	Sample Depth	Borehole Abandonment/ Well Construction Details
	Blows 6"-6"-6"	BPF								
28-36-40	76	65.0 66.5			20	graded; loose; moist to saturated. @61.5' Medium sand: (0,100,0,0); (100% medium sand). Coarse sand: (0,100,0,0); gray (5Y 5/1); non-plasticity; (10% very coarse, 60% coarse, 30% medium sand); angular-subangular; poorly graded; loose; saturated.	SM SW			
70	27-50 for 3"	100	70.0 71.5		70					
75										
80										
85										
90										
95										
100										

Continued Next Page

4" O.D.
0.020"
Slotted PVC
Screen

SB/MW#: **MW-4**
#D- **19260-64**
Page **4** of **4**
Sampler: **S. English**

SOIL DRILLING LOG

PROJECT _____ OFRP _____ LOCATION _____ Santa Fe Springs, CA

SB/MW#: MW-5
 #D- 9257-61
 Page 1 of 4
 Sampler: E. Ferguson

SOIL DRILLING LOG

PROJECT OFRP LOCATION Santa Fe Springs, CA
 ELEVATION ~150' above MSL MONITORING DEVICE QVM
 SAMPLING DATE(S) 12-16-93 START 10:45 AM FINISH 4:30 PM
 SAMPLING METHOD CA MOD SPLIT SPOON SUBCONTRACTOR & EQUIPMENT Gregg Drilling - B-61
 MEMO 6.5" O.D. Hollow Stem Augers were used to sample the borehole, (2" diameter x 6" length brass tubes). 10"
 O.D. Hollow Stem Augers were used to construct the wells. * Continuous sampling began at 60' below
 ground surface.

Depth Below Surface (ft.)	Penetration Results			Sample ID #	Hnu	Reading (ppm)	Soil Description Color, Texture, Moisture, Etc.	Unified Class.	Graphic Log	Sample Depth	Borehole Abandonment/ Well Construction Details
	Blows 6"-6"-6"	BPF	Sampler Depth Interval (ft.)								
0.0											
5	21-19-23	42	5.0 6.5	85851	11		Silt: (0,10,90,0); dark grayish brown (2.5Y 4/2); non-plastic; very stiff; dry; odorous; stained.	ML			Locking PVC Cap Concrete
10	14-26-31	57	8.5 10.0	85852	5						4" O.D. PVC Blank Casing
12.5											
15	6-7-9	16	13.5 15.0	85853	71		Medium Sand: (0,95,5,0); dark brown (7.5YR 4/2); non-plastic; (90% medium, 10% fine to very fine sand); subangular to subrounded; poorly graded; loose; dry; odorous.	SP			
17.5											
20	38-50 for 5"	100	18.5 20.0	85854	434		Silt: (0,0,95,5); light brownish gray (2.5Y 6/2); low plastic; very stiff; dry.	ML			Bentonite Chips
25	16-28-38	66	23.5 25.0	85855	410		@25' (0,5,90,5), olive brown (2.5Y 4/4).				
27.5											
30	29-32-36	68	28.5	85856	63		Medium sand: (2,93,5,0); grayish brown (10YR 5/2); (salt & pepper);	SP			
							Continued Next Page				

SB/MW#: MW-5

#D- 9257-61

Page 2 of 4

Sampler: E. Ferguson

SOIL DRILLING LOG

PROJECT

OFRP

LOCATION

Santa Fe Springs, CA

Depth Below Surface (ft.)	Penetration Results		Sample Interval (ft.)	Sample ID #	Hnu Reading (PPM)	Soil Description Color, Texture, Moisture, Etc.	Unified Class:	Graphic Log	Sample Depth	Borehole Abandonment/ Well Construction Details		
	Blows 6'-6"-6"	BPF										
30			30.0									
35	28-39-40	79	33.5	85857	27	non-plastic; (10% coarse, 75% medium, 15% fine to very fine sand); subangular to subrounded; graded; loose; damp; odorous. @35' (2,93,5,0); (15% coarse, 75% medium, 10% fine to very fine sand); odorous.					4" O.D. PVC Blank Casing	
40	30-40-50 for 5"	100	38.5 40.0	85858	4							
45	38-50 for 5"	100	43.5 45.0	85859	1							
50	12-23-50	73	48.5 50.0	85860	246	@45' (5,95,0,0); (5% very coarse, 30% coarse, 55% medium, 10% fine to very fine sand). Silt: (0,0,95,5); light brownish gray (2.5Y 6/2); low plastic; stiff; damp.	ML				Bentonite Chips	
55	19-21-48	69	53.5 55.0		2							
60	14-14-50	64	60.0 60.0		3	Sandy silt: (0,40,60,0); olive yellow (5Y 6/6); non-plastic; slightly stiff; damp.	ML					
65						63.0 Fine sand: (0,100,0,0); gray (5YR 5/1); (salt & Bentonite Pellets	SP					

Continued Next Page

SB/MW#: MW-5
#D- 9257-61
Page 3 of 4
Sampler: E. Ferguson

SOIL DRILLING LOG

PROJECT OFRP LOCATION Santa Fe Springs, CA

Depth Below Surface (ft.)	Penetration Results		Sample Interval (ft.)	Hnu Reading (ppm)	Soil Description Color, Texture, Moisture, Etc.	Unified Class.	Graphic Log	Sample Depth	Borehole Abandonment/ Well Construction Details
	Blows 6"-6"-6"	BPF							
65.0			16	67.5	pepper); non-plastic; (5% medium, 90% fine, 5% fine sand. @64.5' (2% very coarse, 8% coarse, 10% medium, 75% fine, 5% very fine sand).	SP			
65.0			4	70.5	Medium sand: (0,100,0,0); dark gray (5YR 4/1); (salt & pepper); non-plastic; (10% coarse, 90% medium sand); poorly graded; loose; moist. @69' Saturated.	SP		#2/12 Sand	
70.0				75.0	Coarse sand: (5,95,0,0); dark gray (5Y 4/1); (salt & pepper); non-plastic; (35% very coarse, 60% coarse, 5% medium sand); graded; loose; saturated.	SP			
70.0				82.0	Medium sand: (0,100,0,0); dark gray (5YR 4/1); (salt & pepper); non-plastic; (60% medium, 40% fine sand); graded; loose; saturated. @81' Dark reddish gray (5YR 4/2).	ML			
75				84.0	4" lens of Silt: (0,0,100,0); dark gray (5Y 4/1); low-plastic; stiff; damp.	SP			
80					Coarse sand: (0,100,0,0); dark gray (10YR 4/1); non-plastic; (60% coarse, 35% medium, 5% fine sand); graded; saturated.				
85									
90									
95									
100					Medium Sand: (0,100,0,0); very dark grayish brown (10YR 3/2); non-plastic;	SP			

Continued Next Page

SB/MW#: **MW-5**

#D- 9257-61

Page 4 of 4

Sampler: E. Ferguson

SOIL DRILLING LOG

PROJECT

QFRP

LOCATION

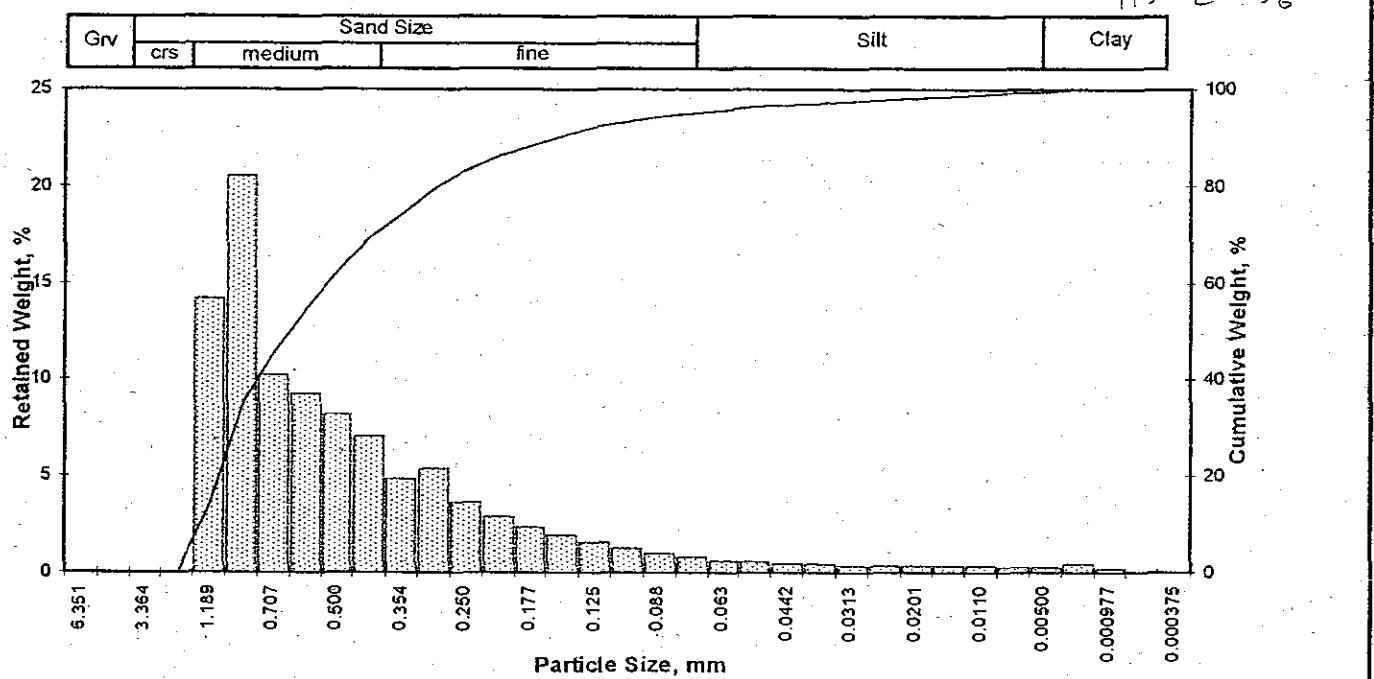
Santa Fe Springs, CA

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client: Alton Geoscience
 Project: Mobil Jalk Fee
 Project No: N/A

PTS File No: 27224
 Sample ID: GG02233
 Depth, ft: 45 - Z - 56' N/A



Opening Inches	Opening Millimeters	Phi of Screen	U.S. No.	Incremental Weight, percent	Cumulative Weight, percent
0.2500	6.351	-2.67	1/4	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00
0.0468	1.189	-0.25	16	14.18	14.18
0.0331	0.841	0.25	20	20.48	34.66
0.0278	0.707	0.50	25	10.24	44.90
0.0234	0.595	0.75	30	9.23	54.13
0.0197	0.500	1.00	35	8.19	62.32
0.0166	0.420	1.25	40	7.03	69.35
0.0139	0.354	1.50	45	4.86	74.20
0.0117	0.297	1.75	50	5.41	79.61
0.0098	0.250	2.00	60	3.65	83.26
0.0083	0.210	2.25	70	2.94	86.20
0.0070	0.177	2.50	80	2.35	88.55
0.0059	0.149	2.75	100	1.97	90.52
0.0049	0.125	3.00	120	1.60	92.12
0.0041	0.105	3.25	140	1.26	93.38
0.0035	0.088	3.50	170	0.99	94.38
0.0029	0.074	3.75	200	0.79	95.16
0.0025	0.063	4.00	230	0.63	95.80
0.0021	0.053	4.25	270	0.51	96.30
0.00174	0.0442	4.50	325	0.44	96.75
0.00146	0.0372	4.75	400	0.40	97.15
0.00123	0.0313	5.00	450	0.35	97.50
0.000986	0.0250	5.32	500	0.39	97.89
0.000790	0.0201	5.64	635	0.34	98.22
0.000615	0.0156	6.00		0.32	98.54
0.000435	0.0110	6.50		0.35	98.89
0.000308	0.00781	7.00		0.27	99.16
0.000197	0.00500	7.65		0.28	99.44
0.000077	0.00195	9.00		0.41	99.85
0.000038	0.000977	10.00		0.14	99.99
0.000019	0.000488	11.00		0.01	100.00
0.000015	0.000375	11.38		0.00	100.00
TOTALS				100.00	100.00

Cumulative Weight Percent greater than			
Weight percent	Phi Value	Inches	Millimeters
5	-0.74	0.0656	1.665
10	-0.47	0.0546	1.386
16	-0.21	0.0454	1.153
25	-0.01	0.0390	0.990
40	0.38	0.0302	0.768
50	0.64	0.0253	0.643
60	0.93	0.0207	0.525
75	1.54	0.0136	0.345
84	2.06	0.0094	0.239
90	2.68	0.0061	0.156
95	3.70	0.0030	0.077

Measure	Trask	Inman	Folk-Ward
Median, phi	0.64	0.64	0.64
Median, in.	0.0253	0.0253	0.0253
Median, mm	0.643	0.643	0.643
Mean, phi	0.58	0.93	0.83
Mean, in.	0.0263	0.0207	0.0221
Mean, mm	0.667	0.525	0.562
Sorting	0.590	1.134	1.239
Skewness	0.909	0.256	0.318
Kurtosis	0.262	0.955	1.194
Grain Size Description (ASTM-USCS Scale)		Medium sand (based on Mean from Trask)	
Description	Retained on Sieve #	Weight Percent	
Gravel	4	0.00	
Coarse Sand	10	0.00	
Medium Sand	40	69.35	
Fine Sand	200	25.82	
Silt	>0.005 mm	4.28	
Clay	<0.005 mm	0.56	
	Total	.100	

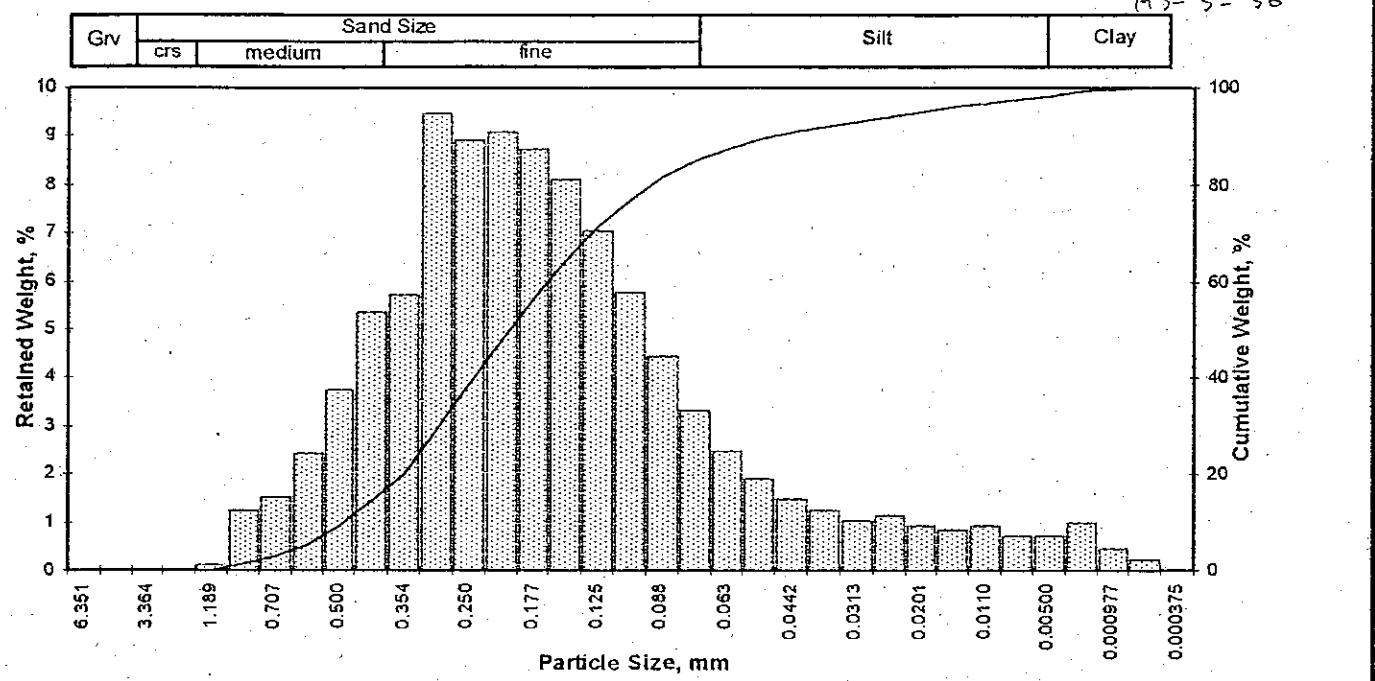
PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client: Alton Geoscience
 Project: Mobil Jack Fee
 Project No: N/A

PTS File No: 27224
 Sample ID: GG02221
 Depth, ft: N/A

(HS-3-56)



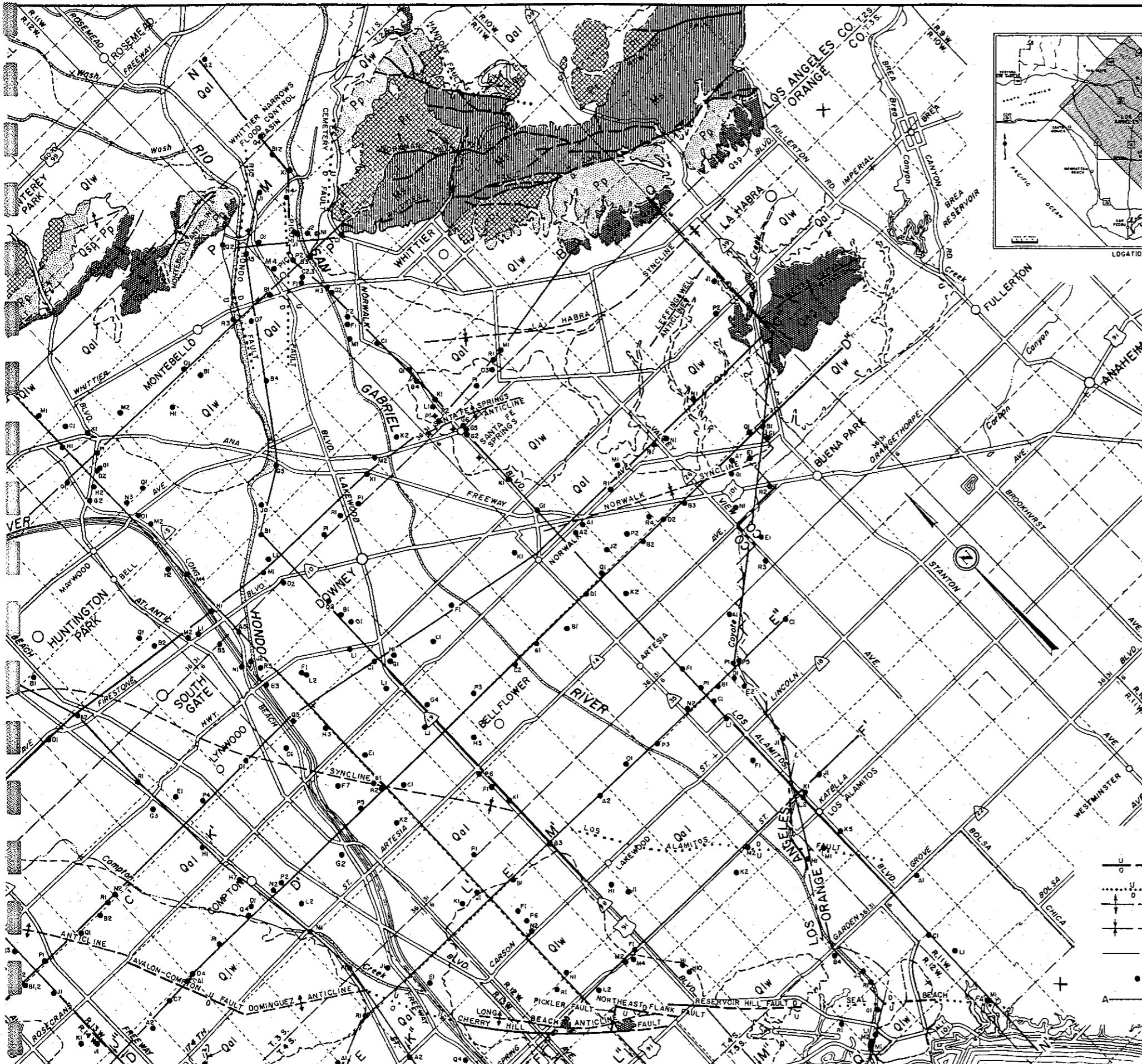
Opening Inches	Opening Millimeters	Phi of Screen	U.S. No.	Incremental Weight, percent	Cumulative Weight, percent
0.2500	6.351	-2.67	1/4	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00
0.0468	1.189	-0.25	16	0.10	0.10
0.0331	0.841	0.25	20	1.22	1.32
0.0278	0.707	0.50	25	1.52	2.84
0.0234	0.595	0.75	30	2.43	5.27
0.0197	0.500	1.00	35	3.74	9.01
0.0166	0.420	1.25	40	5.34	14.35
0.0139	0.354	1.50	45	5.71	20.06
0.0117	0.297	1.75	50	9.48	29.54
0.0098	0.250	2.00	60	8.92	38.46
0.0083	0.210	2.25	70	9.09	47.55
0.0070	0.177	2.50	80	8.74	56.29
0.0059	0.149	2.75	100	8.11	64.40
0.0049	0.125	3.00	120	7.05	71.45
0.0041	0.105	3.25	140	5.77	77.22
0.0035	0.088	3.50	170	4.44	81.66
0.0029	0.074	3.75	200	3.32	84.98
0.0025	0.063	4.00	230	2.48	87.46
0.0021	0.053	4.25	270	1.89	89.35
0.00174	0.0442	4.50	325	1.48	90.83
0.00146	0.0372	4.75	400	1.22	92.05
0.00123	0.0313	5.00	450	1.02	93.07
0.000986	0.0250	5.32	500	1.11	94.18
0.000790	0.0201	5.64	635	0.92	95.10
0.000615	0.0156	6.00		0.86	95.95
0.000435	0.0110	6.50		0.93	96.88
0.000308	0.00781	7.00		0.72	97.60
0.000197	0.00500	7.65		0.72	98.32
0.000077	0.00195	9.00		1.00	99.32
0.000038	0.000977	10.00		0.44	99.76
0.000019	0.000488	11.00		0.22	99.98
0.000015	0.000375	11.38		0.02	100.00
TOTALS				100.00	100.00

Cumulative Weight Percent greater than			
Weight percent	Phi Value	Inches	Millimeters
5	0.72	0.0239	0.606
10	1.05	0.0191	0.484
16	1.32	0.0157	0.400
25	1.63	0.0127	0.323
40	2.04	0.0096	0.243
50	2.32	0.0079	0.200
60	2.61	0.0064	0.163
75	3.15	0.0044	0.112
84	3.68	0.0031	0.078
90	4.36	0.0019	0.049
95	5.61	0.0008	0.021

Measure	Trask	Inman	Folk-Ward
Median, phi	2.32	2.32	2.32
Median, in.	0.0079	0.0079	0.0079
Median, mm	0.200	0.200	0.200
Mean, phi	2.20	2.50	2.44
Mean, in.	0.0086	0.0070	0.0073
Mean, mm	0.218	0.177	0.184
Sorting	0.590	1.177	1.323
Skewness	0.951	0.152	0.249
Kurtosis	0.242	1.075	1.314

Grain Size Description (ASTM-USCS Scale) Fine sand (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	14.35
Fine Sand	200	70.63
Silt	>0.005 mm	13.34
Clay	<0.005 mm	1.68
Total		100



LEGEND

- FAULT (ASHEO WHERE APPROXIMATELY LOCATED; U-UPTHROWN SIDE; D-DOWNTHROWN SIDE)
- CONCEALED FAULT
- ANTICLINE (DASHED WHERE APPROXIMATELY LOCATED)
- SYNCLINE (DASHED WHERE APPROXIMATELY LOCATED)
- CONTACT (DASHED WHERE APPROXIMATELY LOCATED)
- WELLS USED IN PREPARATION OF GEOLOGIC SECTIONS.
- LINE LOCATION OF GEOLOGIC SECTIONS SHOWN ON PLATES 64 THROUGH 6G.

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN CALIFORNIA DISTRICT

GROUND WATER GEOLOGY OF THE
COASTAL PLAIN OF
LOS ANGELES COUNTY

AREAL GEOLOGY

SCALE OF MILES
0 1 2 3
1961

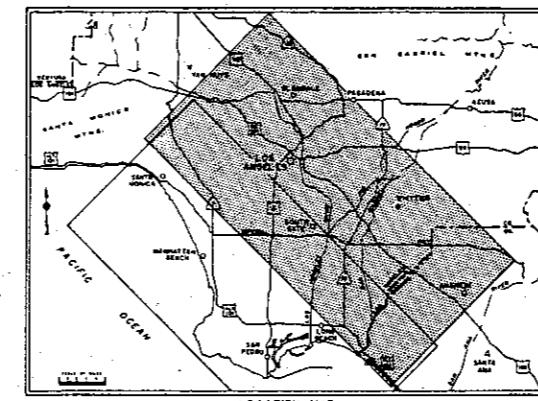
LEGEND

SEDIMENTARY ROCKS

Qdt	ALLUVIUM GRAVEL, SAND, SILT, AND CLAY
Qsr	ACTIVE DUNE SAND WHITE OR GREYISH, WELL SORTED SAND
Qd	OLDER DUNE SAND FINE TO MEDIUM SAND WITH SILT, AND GRAVEL LENSES
Qw	LAKWOOD FORMATION (INCLUDES "TERRACE DEPOSITS", "PALOS VERDES SAND", AND "UNNAMED UPPER PLEISTOCENE DEPOSITS") MARINE AND CONTINENTAL GRAVEL, SAND, SANDY SILT, SILT, AND CLAY WITH SHALE PEBBLES
Ql	SAN PEDRO FORMATION (INCLUDES "LA HABRA CONGLOMERATE" AND PART OF "SAUGUS FORMATION") MARINE AND CONTINENTAL GRAVEL, SAND, SANDY SILT, SILT, AND CLAY
Qsp-Pp	UNDIFFERENTIATED SAN PEDRO FORMATION AND/OR PICO FORMATION MARINE, PARTIALLY CONSOLIDATED GRAVEL, SAND, SILT, AND CLAY
Pp	PICO FORMATION MARINE SAND, SILT, AND CLAY INTERBEDDED WITH GRAVEL
Pr	REPETTO FORMATION MARINE SILSTONE WITH LAYERS OF SANDSTONE AND CONGLOMERATE
Ma	(SANTA MONICA MOUNTAINS) MOBLO FORMATION MARINE CONGLOMERATIC SANDSTONE, SANDSTONE, AND SHALE
Tp	TOPANGA FORMATION MARINE CONGLOMERATE, SANDSTONE, AND SHALE
Ms	(PALOS VERDES HILLS) MONTEREY FORMATION MUDSTONE, DIATRHITE, AND SHALE
El	(ELTSIGA HILLS, REPETTO HILLS, AND PUENTE HILLS) PUENTE FORMATION MARINE SILSTONE, SANDSTONE, SHALE, CONGLOMERATE, LIMESTONE, AND TUFF
Qb	VEQUEROS BND SENSE FORMATIONS CONTINENTAL AND CONGLOMERATE AND SANDSTONE
E	MARTINEZ FORMATION MARINE CONGLOMERATE, SANDSTONE, SANDY SHALE, AND CLAY
E-K	UNDIVIDED MARTINEZ AND CHICO FORMATIONS
K3	CHICO FORMATION UPPER MARINE MEMBER-HARD CONGLOMERATE, SANDSTONE, AND SHALE LOWER CONTINENTAL MEMBER-RED CONGLOMERATE AND SANDSTONE

IGNEOUS AND METAMORPHIC ROCKS

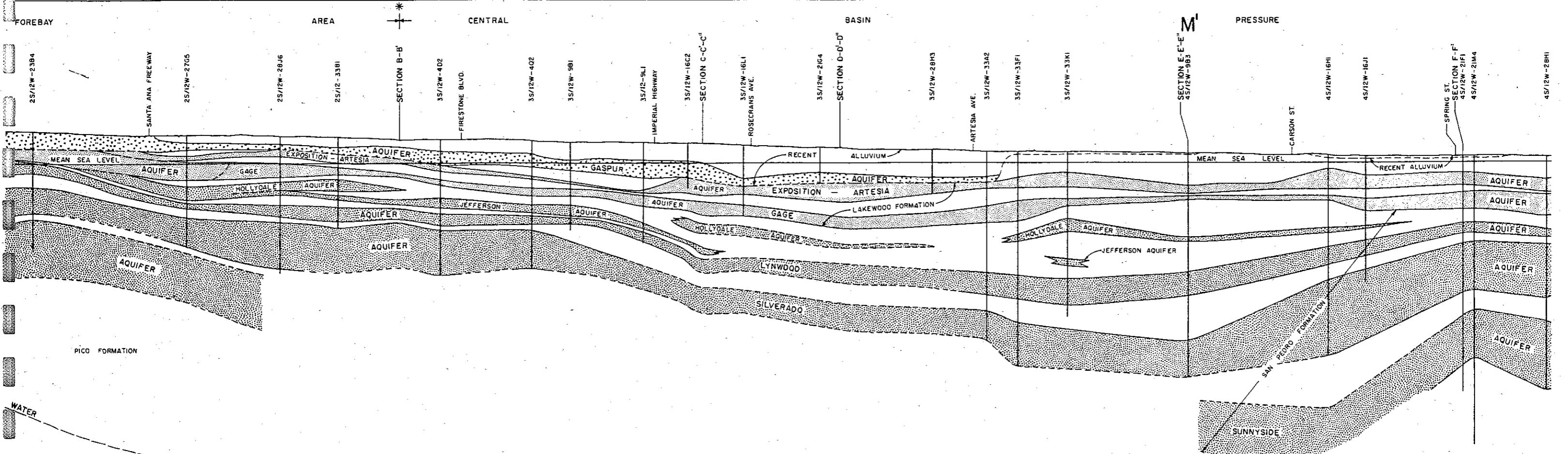
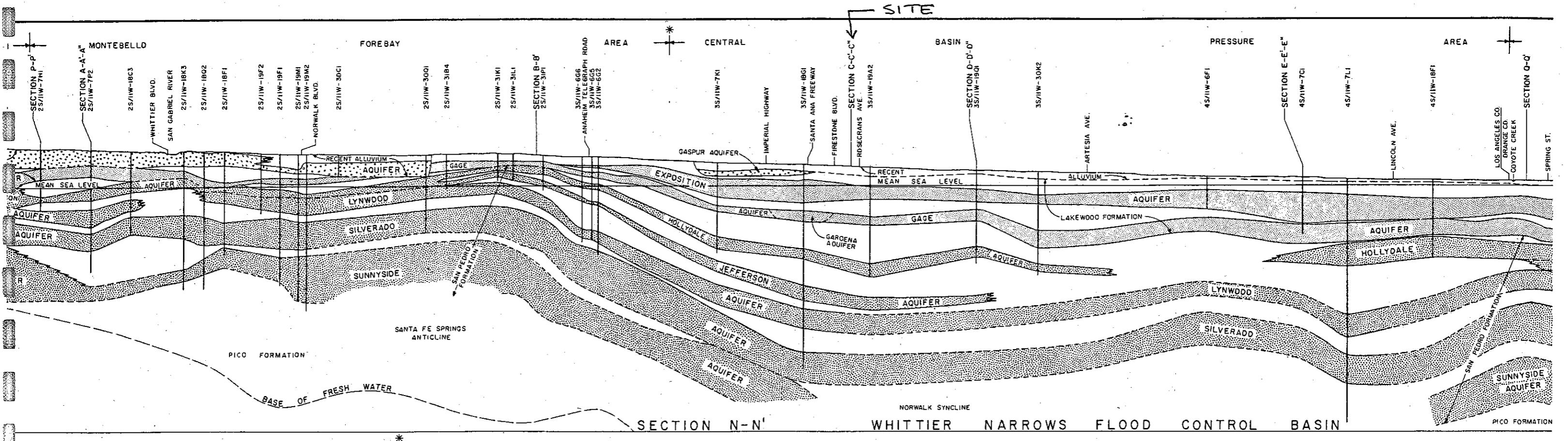
M	MIDDLE MIocene VOLCANIC ROCKS ASSOCIATED WITH TUFFS, AND INFUSIONES, CHIEFLY ASSALTIC AND ANDESITIC WITH OCCASIONAL ACIB ROCKS GENERALLY ASSOCIATED WITH TOPANGA, MOBLO, AND PUENTE FORMATIONS
I	(SANTA MONICA MOUNTAINS) INTRUSIVES OF GROHITE AND GRANODIORITE
J	(PALOS VERDES HILLS) CATALINA SCHIST, COMPARED WITH FRANCISCAN FORMATION OF THE COAST RANGES, VARIED TYPES OF SCHISTOSE ROCKS
R	SANTA MONICA SLATE GREY TO BLACK SLATE, SPOTTED SLATE, MICA SCHIST WITH QUARTZ VEINS



QUATERNARY

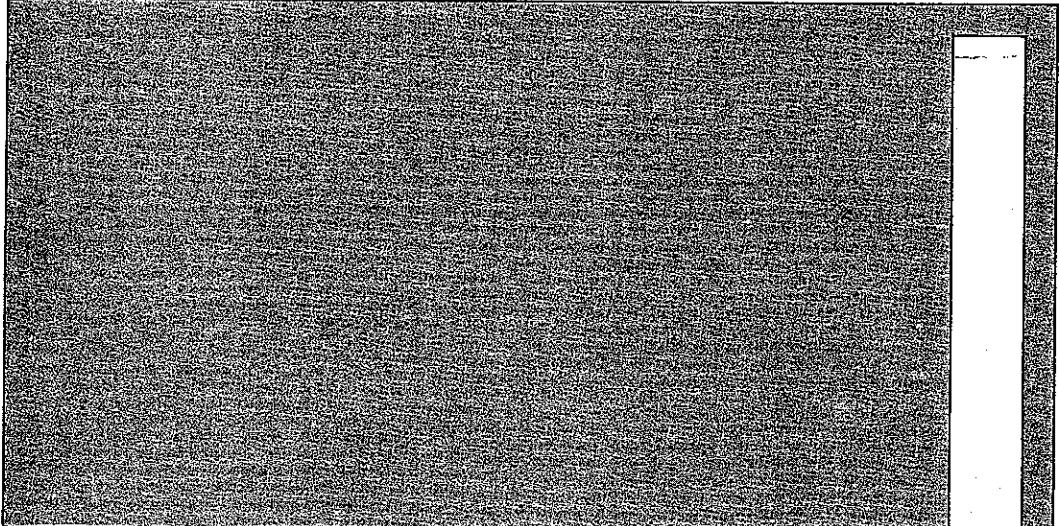
RECENT
UPPER
LOWERPLEISTOCENE
PILOCENEMIocene
OLIGOCENE(?)EOCENE
PALEOCENE(?)CRETA-CEUS
MIocene
UPPERCRETA-CEUS
TERTIARY

TERTIARY



SECTION M-M'-M" — WHITTIER NARROWS DAM SOUTHERLY TO THE PACIFIC OCEAN WEST OF SEAL BEACH

ATTACHMENT 3



R. Allan Freeze

Department of Geological Sciences
University of British Columbia
Vancouver, British Columbia

John A. Cherry

Department of Earth Sciences
University of Waterloo
Waterloo, Ontario

GROUNDWATER

Prentice-Hall, Inc.
Englewood Cliffs, New Jersey 07632

free conductance
all, so petroleum
2.28) is substituted

(2.29)

that will lead to
under a hydraulic
darcy is approxi-

used for hydraulic
d in terms of Eq.

with regard to this
ficient. However,
arded this formal
erature of measure-
ment can influence
2.28). The effect is
still makes good
have been carried
surement are very
dependent on the
al rather than con-

tivity and perme-
ological materials.
(1969) review. The
draulic conductivity
eters that take on
roperty implies that
n be very useful.
alue probably has

ous common units
in be converted to
version from ft^2 to

Table 2.2 Range of Values of Hydraulic Conductivity
and Permeability

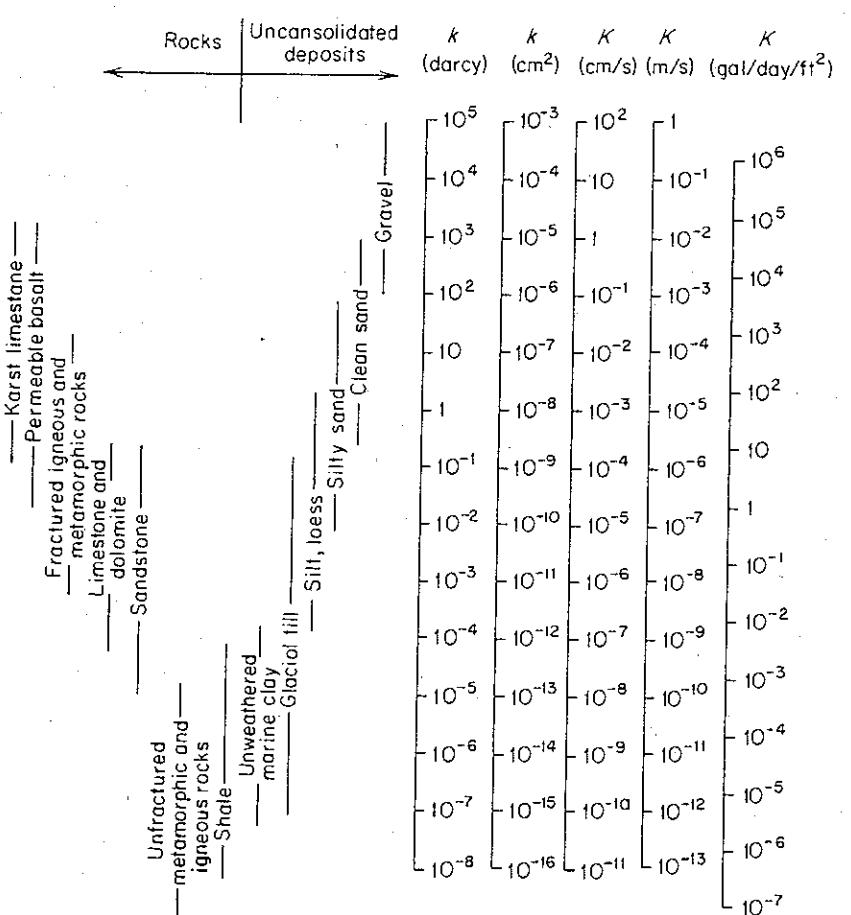


Table 2.3 Conversion Factors for Permeability
and Hydraulic Conductivity Units

	Permeability, k^*			Hydraulic conductivity, K		
	cm^2	ft^2	darcy	m/s	ft/s	U.S. gal/day/ ft^2
cm^2	1	1.08×10^{-3}	1.01×10^8	9.80×10^2	3.22×10^3	1.85×10^9
ft^2	9.29×10^2	1	9.42×10^{10}	9.11×10^5	2.99×10^6	1.71×10^{12}
darcy	9.87×10^{-9}	1.06×10^{-11}	1	9.66×10^{-6}	3.17×10^{-5}	1.82×10^1
m/s	1.02×10^{-3}	1.10×10^{-6}	1.04×10^5	1	3.28	2.12×10^6
ft/s	3.11×10^{-4}	3.35×10^{-7}	3.15×10^4	3.05×10^{-1}	1	6.46×10^5
U.S. gal/day/ ft^2	5.42×10^{-10}	5.83×10^{-13}	5.49×10^{-2}	4.72×10^{-7}	1.55×10^{-6}	1

*To obtain k in ft^2 , multiply k in cm^2 by 1.08×10^{-3} .

ATTACHMENT 4

axis ;coord - a2 format
 JALK - Passive transport from a residual source
 Full flow and transport - density, vapourization, infiltration
 01/31/01 Walther ;DATE,OPRTR - 2(2X,A8) format
 T F T ;IGGRD,ISTRTI,ISTRTO
 T T F T ;IVISC,IDIFF,IPERM,ISDPL
 T T F ;ISTOR,IVAF,IFLOW,ISTED
 T T F ;IDENS,ITRAN
 F F T ;ITFF,ITFT,IITER
 T T F ;IMBAL,IACC1,IACC2
 F F F ;IPCON,IPPOT,IPVEL
 T T T F F ;IFCON,IPFOT,IFVEL,IFGRD,IFNOD
 F ;IFBIN
 O ;NEOUT
 O ;NNOUT
 1.000 ;THICK
 0.60 ;XMIN
 40 20 ;NHORE,NVETE
 6 1 ;III,JJJ
 9 15 22 28 36 40 ;IH(I),I=1,III
 20 ;IV(J),J=1,JJJ
 0.60 1.00 2.00 3.00 4.00 6.00 ;HOR(I),I=1,III
 1.07 ;VER(J),J=1,JJJ
 2 2 1 'zn'
 3 423 21 'sr'
 425 438 1 'sr'
 19 439 21 'sr'
 20 20 1 'zn'
 21 861 21 'gs'
 842 860 1 'zn'
 1 841 21 'wt'
 0 0 0 'end'
 0 0 0 0 ;JN1,JN2,JE,JNCOL,DIR
 0 0 0 0.00D-00 ;J1,J2,JN,TRANS
 1 22 1 40 1.21D-08 ;JN1,JN2,JE,JNCOL,SFLX
 8.20D-10 ;DWTR
 1.50D-05 1.80D-05 165.85 28.75 ;USOLV,UAIR,GMSOLV,GMAIR
 101.33 17.8 0.00D-00 ;PRESS,TEMP,COMP
 1 560 9.00D-13 9.00D-13 2.00 0.5000 0.5000 ;J1,J2,PKX,PKZ,EXPK,DISPL,DISPT
 0.28 0.07 0.090 1.42 0.0093 ;POR,RMC,SMC,BULK,FOC
 7.40D-06 7.40D-06 0.546 364.00 ;DAIRX,DAIRZ,HENRY,PKOC
 561 960 4.60D-13 4.60D-13 2.00 0.5000 0.5000 ;J1,J2,PKX,PKZ,EXPK,DISPL,DISPT
 0.28 0.07 0.090 1.65 0.0093 ;POR,RMC,SMC,BULK,FOC
 7.40D-06 7.40D-06 0.546 364.00 ;DAIRX,DAIRZ,HENRY,PKOC
 961 1040 4.00D-17 4.00D-17 2.00 0.5000 0.5000 ;J1,J2,PKX,PKZ,EXPK,DISPL,DISPT
 0.28 0.07 0.090 1.49 0.0093 ;POR,RMC,SMC,BULK,FOC
 7.40D-06 7.40D-06 0.546 364.00 ;DAIRX,DAIRZ,HENRY,PKOC
 1041 1600 9.00D-13 9.00D-13 2.00 0.5000 0.5000 ;J1,J2,PKX,PKZ,EXPK,DISPL,DISPT
 0.28 0.07 0.090 1.52 0.0093 ;POR,RMC,SMC,BULK,FOC
 7.40D-06 7.40D-06 0.546 364.00 ;DAIRX,DAIRZ,HENRY,PKOC
 0 0 0 0.00 ;J1,J2,JN,RATE
 842 860 1 ;J1,J2,JN
 21 861 21
 0 0 0
 3 423 21 ;J1,J2,JN
 4 424 21
 5 425 21
 6 426 21
 7 427 21
 8 428 21
 9 429 21
 10 430 21
 11 431 21
 12 432 21
 13 433 21
 14 434 21
 15 435 21
 16 436 21
 17 437 21
 18 438 21

19	439	21			
21	861	21			
0	0	0			
0	0	0	0.00		
3	423	21	4.910D-05		;J1,J2,JN,UIN
4	424	21	4.910D-05		;J1,J2,JN,CIN
5	425	21	4.910D-05		
6	426	21	4.910D-05		
7	427	21	4.910D-05		
8	428	21	4.910D-05		
9	429	21	4.910D-05		
10	430	21	5.000D-04		
11	431	21	5.000D-04		
12	432	21	5.000D-04		
13	433	21	5.000D-04		
14	434	21	2.060D-04		
15	435	21	2.220D-03		
16	436	21	2.220D-03		
17	437	21	2.220D-03		
18	438	21	2.220D-03		
19	439	21	2.220D-03		
0	0	0	0.00		
			2.290D-03 16.50		
1.00D-05	1.00D-06	30	20	1.00D-09	;CMAX,SMASS
0.00D-00	0.00D-00	1.00D-06			;UCNVRG,CCNVRG,MITER,MDBLI,SCNVRG
0.00D-00	0.00D-00	1.00D-06	5		;ECNVRF,ACNVRF,RCNVRF
0.50	0.50				;ECNVRT,ACNVRT,RCNVRT,NORTHT
1					;TWFF,TWFT
					;NTSTEP
12.00	268800.0	48.00	1280		;DT,FTIME,DTMAX,JPRT

***** V a p o u r T *****

Finite-element Vapour Transport Model
version 2.15
Copyright (c) 1992
Carl Mendoza

JALK - Passive transport from a residual source
Full flow and transport - density, vapourization, infiltration

Date: 01/31/01 jobid: jalk9axi Operator: Walther

Axisymmetric Coordinates

Minimum/maximum R coordinate 0.600 100.000
Minimum/maximum Z coordinate 0.000 21.400

Number of nodes 861
Number of elements 1600
Number of horizontal nodes 41
Number of vertical nodes 21

Mass balance boundary
nodes 2 to 2 by 1 zn
nodes 3 to 423 by 21 sr
nodes 425 to 438 by 1 sr
nodes 19 to 439 by 21 sr
nodes 20 to 20 by 1 zn
nodes 21 to 861 by 21 gs
nodes 842 to 860 by 1 zn
nodes 1 to 841 by 21 wt
Number mass balance nodes 159

Top/Btm source definition

Non-zero Neumann boundary
Number non-zero Neumann elements 0

Infiltration definition
watertable elements 1 to 80 1.21D-08

Aqueous diffusion coefficient 8.20D-10

Gas viscosities (Pa*s) 1.50D-05 1.80D-05
Gram molecular weights 165.9 28.8
System pressure (Pa) 101.33D+03
System temperature (K) 290.8
System molar concentration 41.912
Reference freshair density 1.20
Fluid compressibility 9.87D-06

Physical properties - layer 1 - elements 1 to 560
Intrinsic permeabilities 9.00D-13 9.00D-13
Dispersivities 0.500 0.500
Porosity 0.280
Residual/soil moisture 0.070 0.090
Bulk density/foc 1.420 9.30D-03
Diffusion coefficients 7.40D-06 7.40D-06
Henry's Law constant 0.546
Koc 3.64D+02
Effective permeabilities 9.00D-13 9.00D-13

Gaseous diffusion coefficients	1.96D-06	1.96D-06
Aqueous diffusion coefficients	3.80D-11	3.80D-11
Air-filled porosity	0.190	
Water/soil retardation	0.868	46.337
Total retardation	48.204	

Physical properties - layer 2 - elements	561 to 960	
Intrinsic permeabilities	4.60D-13	4.60D-13
Dispersivities	0.500	0.500
Porosity	0.280	
Residual/soil moisture	0.070	0.090
Bulk density/foc	1.650	9.30D-03
Diffusion coefficients	7.40D-06	7.40D-06
Henry's Law constant	0.546	
Koc	3.64D+02	
Effective permeabilities	4.60D-13	4.60D-13
Gaseous diffusion coefficients	1.96D-06	1.96D-06
Aqueous diffusion coefficients	3.80D-11	3.80D-11
Air-filled porosity	0.190	
Water/soil retardation	0.868	53.842
Total retardation	55.710	

Physical properties - layer 3 - elements	961 to 1040	
Intrinsic permeabilities	4.00D-17	4.00D-17
Dispersivities	0.500	0.500
Porosity	0.280	
Residual/soil moisture	0.070	0.090
Bulk density/foc	1.490	9.30D-03
Diffusion coefficients	7.40D-06	7.40D-06
Henry's Law constant	0.546	
Koc	3.64D+02	
Effective permeabilities	4.00D-17	4.00D-17
Gaseous diffusion coefficients	1.96D-06	1.96D-06
Aqueous diffusion coefficients	3.80D-11	3.80D-11
Air-filled porosity	0.190	
Water/soil retardation	0.868	48.621
Total retardation	50.489	

Physical properties - layer 4 - elements	1041 to 1600	
Intrinsic permeabilities	9.00D-13	9.00D-13
Dispersivities	0.500	0.500
Porosity	0.280	
Residual/soil moisture	0.070	0.090
Bulk density/foc	1.520	9.30D-03
Diffusion coefficients	7.40D-06	7.40D-06
Henry's Law constant	0.546	
Koc	3.64D+02	
Effective permeabilities	9.00D-13	9.00D-13
Gaseous diffusion coefficients	1.96D-06	1.96D-06
Aqueous diffusion coefficients	3.80D-11	3.80D-11
Air-filled porosity	0.190	
Water/soil retardation	0.868	49.600
Total retardation	51.468	

Extraction well nodes

Number of extraction nodes	0
Total volumetric flux	0.00D+00

Dirichlet potential nodes

nodes 842 to 860 by 1	
nodes 21 to 861 by 21	

Dirichlet concentration nodes

nodes 3 to 423 by 21	
nodes 4 to 424 by 21	
nodes 5 to 425 by 21	
nodes 6 to 426 by 21	
nodes 7 to 427 by 21	
nodes 8 to 428 by 21	
nodes 9 to 429 by 21	
nodes 10 to 430 by 21	

nodes 11 to 431 by 21
nodes 12 to 432 by 21
nodes 13 to 433 by 21
nodes 14 to 434 by 21
nodes 15 to 435 by 21
nodes 16 to 436 by 21
nodes 17 to 437 by 21
nodes 18 to 438 by 21
nodes 19 to 439 by 21
nodes 21 to 861 by 21

Number of Dirichlet potential nodes 60
Potential degrees of freedom 801

Number of Dirichlet concentration nodes 398
Concentration degrees of freedom 463

Non-static initial pressures

Non-zero initial concentrations

nodes 3 to 423 by 21 0.000
nodes 4 to 424 by 21 0.000
nodes 5 to 425 by 21 0.000
nodes 6 to 426 by 21 0.000
nodes 7 to 427 by 21 0.000
nodes 8 to 428 by 21 0.000
nodes 9 to 429 by 21 0.000
nodes 10 to 430 by 21 0.001
nodes 11 to 431 by 21 0.001
nodes 12 to 432 by 21 0.001
nodes 13 to 433 by 21 0.001
nodes 14 to 434 by 21 0.000
nodes 15 to 435 by 21 0.002
nodes 16 to 436 by 21 0.002
nodes 17 to 437 by 21 0.002
nodes 18 to 438 by 21 0.002
nodes 19 to 439 by 21 0.002

Maximum concentration 0.002

Original source mass 16.50

Saturated relative vapour density 1.000

Source volume 2.60D+04

Number of calculated source nodes 357

Initial system mass (Kg) 1.67D+01

Potential convergence tolerance (m) 1.00D-05

Concentration convergence tolerance (%) 1.00D-06

Steady-state convergence tolerance (%/h) 1.00D-09

Maximum number double iterations 20

Iterative solver parameters (flow)

Residual convergence 0.00D+00
Absolute convergence 0.00D+00
Relative convergence 1.00D-06

Iterative solver parameters (transport)

Residual convergence 0.00D+00
Absolute convergence 0.00D+00
Relative convergence 1.00D-06
Number of orthogonalizations 5

Binary viscosity formula used

Vapourization flux included

Source allowed to deplete

Density-dependent flow included

Flow time weighting factor 0.50
Lumped flow storage formulation

Transport time weighting factor 0.50
Lumped transport storage formulation

Time step (hrs) 12.00

Source depleted after 0.5 days

Number iterations first time step 2

Iterations stopped at step # 21 time 252.0 hours

1 Statistics: time.= 15360.00 hours/ 640.00 days (time step 1280)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	1081
Maximum peclet(z) number	0.127	1240
Maximum courant(x) number	0.000	1081
Maximum courant(z) number	0.000	518
Maximum courant/peclet(x) ratio	0.005	498
Maximum courant/peclet(z) ratio	0.002	518
Maximum x/z aspect ratio	3.18	255
Minimum x/z aspect ratio	0.0318	1193

Time step mass balance

Absolute error (Kg)	8.34D-11
Percent error	0.000

Cumulative mass balance

Absolute error (Kg)	1.05D-07
Percent error	0.000

Boundary mass summary (Kg)

	surface watertable	lateral	source	extract	net
Time step	-1.07D-03	-2.40D-06	-2.75D-46	0.00D+00	0.00D+00
Cumulative	-1.24D+00	-1.46D-03	-1.85D-44	1.67D+01	0.00D+00

Stored mass summary (Kg)

	vapour	moisture	solids	net
Time step	-2.13D-05	-1.85D-05	-1.04D-03	-1.08D-03
Cumulative	2.97D-01	2.57D-01	1.49D+01	1.54D+01

Time step vapourization flux (m^3/s) 0.00D+00

Time step extraction flux (m^3/s) 0.00D+00

Total ORTHOMIN flow iterations 1
Total ORTHOMIN transport iterations 2

Air-phase velocity range

Minimum X velocity (m/s)	-2.00D-11	922
Maximum X velocity (m/s)	1.35D-10	1081

Minimum Z velocity (m/s)	-5.80D-11	1240
Maximum Z velocity (m/s)	4.33D-11	1243

1 Statistics: time = 30720.00 hours/1280.00 days (time step 2560)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	1081
Maximum peclet(z) number	0.127	1557
Maximum courant(x) number	0.000	1081
Maximum courant(z) number	0.000	518
Maximum courant/peclet(x) ratio	0.005	498
Maximum courant/peclet(z) ratio	0.002	518
Maximum x/z aspect ratio	3.18	255
Minimum x/z aspect ratio	0.0318	1195

Time step mass balance

Absolute error (Kg)	4.73D-11
Percent error	0.000

Cumulative mass balance

Absolute error (Kg)	1.86D-07
Percent error	0.000

Boundary mass summary (Kg)

	surface watertable	lateral	source	extract	net
Time step	-8.23D-04	-3.51D-06	-1.97D-40	0.00D+00	0.00D+00
Cumulative	-2.45D+00	-5.30D-03	-2.66D-38	1.67D+01	0.00D+00
					1.42D+01

Stored mass summary (Kg)

	vapour	moisture	solids	net
Time step	-1.64D-05	-1.42D-05	-7.96D-04	0.00D+00
Cumulative	2.73D-01	2.36D-01	1.37D+01	0.00D+00
				1.42D+01

Time step vapourization flux (m^3/s) 0.00D+00

Time step extraction flux (m^3/s) 0.00D+00

Total ORTHOMIN flow iterations 1
Total ORTHOMIN transport iterations 2

Air-phase velocity range

Minimum X velocity (m/s)	-1.96D-11	922
Maximum X velocity (m/s)	9.57D-11	1081
Minimum Z velocity (m/s)	-3.92D-11	1557
Maximum Z velocity (m/s)	2.78D-11	1325

1 Statistics: time = 46080.00 hours/1920.00 days (time step 3840)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	1081
Maximum peclet(z) number	0.127	1555
Maximum courant(x) number	0.000	1081
Maximum courant(z) number	0.000	518
Maximum courant/peclet(x) ratio	0.005	498
Maximum courant/peclet(z) ratio	0.002	518
Maximum x/z aspect ratio	3.18	258
Minimum x/z aspect ratio	0.0318	1196

Time step mass balance

Absolute error (Kg)	2.81D-11
Percent error	0.000

Cumulative mass balance

Absolute error (Kg)	2.33D-07
Percent error	0.000

Boundary mass summary (Kg)

	surface watertable	lateral	source	extract	net
Time step	-6.39D-04	-4.64D-06	-4.55D-37	0.00D+00	0.00D+00
Cumulative	-3.37D+00	-1.05D-02	-9.22D-35	1.67D+01	0.00D+00

Stored mass summary (Kg)

	vapour	moisture	solids	net
Time step	-1.26D-05	-1.10D-05	-6.20D-04	-6.43D-04
Cumulative	2.54D-01	2.20D-01	1.28D+01	1.33D+01

Time step vapourization flux (m^3/s) 0.00D+00

Time step extraction flux (m^3/s) 0.00D+00

Total ORTHOMIN flow iterations 1
Total ORTHOMIN transport iterations 2

Air-phase velocity range

Minimum X velocity (m/s)	-1.90D-11	922
Maximum X velocity (m/s)	7.21D-11	1081
Minimum Z velocity (m/s)	-2.86D-11	1555
Maximum Z velocity (m/s)	1.90D-11	1245

1 Statistics: time = 61440.00 hours/2560.00 days (time step 5120)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	1081
Maximum peclet(z) number	0.127	1555
Maximum courant(x) number	0.000	1081
Maximum courant(z) number	0.000	516
Maximum courant/peclet(x) ratio	0.005	498
Maximum courant/peclet(z) ratio	0.002	516
Maximum x/z aspect ratio	3.18	735
Minimum x/z aspect ratio	0.0318	1193

Time step mass balance

Absolute error (Kg)	1.76D-11
Percent error	0.000

Cumulative mass balance

Absolute error (Kg)	2.62D-07
Percent error	0.000

Boundary mass summary (Kg)

	surface watertable	lateral	source	extract	net
Time step	-5.11D-04	-6.21D-06	-1.00D-34	0.00D+00	0.00D+00
Cumulative	-4.11D+00	-1.74D-02	-2.72D-32	1.67D+01	0.00D+00

Air-phase velocity range

Minimum X velocity (m/s)	-1.75D-11	922
Maximum X velocity (m/s)	4.55D-11	1081
Minimum Z velocity (m/s)	-1.75D-11	1555
Maximum Z velocity (m/s)	1.03D-11	1245

1 Statistics: time = 92160.00 hours/3840.00 days (time step 7680)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	1081
Maximum peclet(z) number	0.127	1553
Maximum courant(x) number	0.000	1081
Maximum courant(z) number	0.000	516
Maximum courant/peclet(x) ratio	0.005	498
Maximum courant/peclet(z) ratio	0.002	41
Maximum x/z aspect ratio	3.18	734
Minimum x/z aspect ratio	0.0318	1193

Time step mass balance

Absolute error (Kg)	7.74D-12
Percent error	0.000

Cumulative mass balance

Absolute error (Kg)	2.92D-07
Percent error	0.000

Boundary mass summary (Kg)

	surface watertable	lateral	source	extract	net
Time step	-3.54D-04	-1.06D-05	-1.64D-31	0.00D+00	0.00D+00
Cumulative	-5.19D+00	-3.86D-02	-6.82D-29	1.67D+01	0.00D+00
					-3.65D-04
					1.14D+01

Stored mass summary (Kg)

	vapour	moisture	solids	net
Time step	-6.87D-06	-5.96D-06	-3.52D-04	0.00D+00
Cumulative	2.19D-01	1.90D-01	1.10D+01	0.00D+00
				-3.65D-04
				1.14D+01

Time step vapourization flux (m³/s) 0.00D+00

Time step extraction flux (m³/s) 0.00D+00

Total ORTHOMIN flow iterations	1
Total ORTHOMIN transport iterations	2

Air-phase velocity range

Minimum X velocity (m/s)	-1.66D-11	922
Maximum X velocity (m/s)	3.74D-11	1081
Minimum Z velocity (m/s)	-1.42D-11	1553
Maximum Z velocity (m/s)	7.92D-12	1245

1 Statistics: time = 107520.00 hours/4480.00 days (time step 8960)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	1085
Maximum peclet(z) number	0.127	1553
Maximum courant(x) number	0.000	1081
Maximum courant(z) number	0.000	516
Maximum courant/peclet(x) ratio	0.005	498

Total ORTHOMIN transport iterations 2

Air-phase velocity range

Minimum X velocity (m/s)	-1.41D-11	922
Maximum X velocity (m/s)	2.30D-11	1079
Minimum Z velocity (m/s)	-8.69D-12	1553
Maximum Z velocity (m/s)	4.45D-12	1247

1 Statistics: time = 153600.00 hours/6400.00 days (time step 12800)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	1085
Maximum peclet(z) number	0.127	1549
Maximum courant(x) number	0.000	1079
Maximum courant(z) number	0.000	514
Maximum courant/peclet(x) ratio	0.005	498
Maximum courant/peclet(z) ratio	0.002	39
Maximum x/z aspect ratio	3.18	1214
Minimum x/z aspect ratio	0.0318	1193

Time step mass balance

Absolute error (Kg)	2.02D-12
Percent error	0.000

Cumulative mass balance

Absolute error (Kg)	3.13D-07
Percent error	0.000

Boundary mass summary (Kg)

	surface watertable	lateral	source	extract	net
Time step	-2.07D-04	-2.22D-05	-1.12D-27	0.00D+00	0.00D+00
Cumulative	-6.57D+00	-1.22D-01	-8.16D-25	1.67D+01	0.00D+00
					9.97D+00

Stored mass summary (Kg)

	vapour	moisture	solids	net
Time step	-4.17D-06	-3.62D-06	-2.21D-04	0.00D+00
Cumulative	1.92D-01	1.66D-01	9.61D+00	0.00D+00
				9.97D+00

Time step vapourization flux (m^3/s) 0.00D+00

Time step extraction flux (m^3/s) 0.00D+00

Total ORTHOMIN flow iterations 1

Total ORTHOMIN transport iterations 2

Air-phase velocity range

Minimum X velocity (m/s)	-1.34D-11	920
Maximum X velocity (m/s)	2.01D-11	1079
Minimum Z velocity (m/s)	-7.65D-12	1549
Maximum Z velocity (m/s)	4.11D-12	527

1 Statistics: time = 168960.00 hours/7040.00 days (time step 14080)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	1085
Maximum peclet(z) number	0.127	514
Maximum courant(x) number	0.000	1079

Maximum courant(z) number	0.000	514				
Maximum courant/peclet(x) ratio	0.005	498				
Maximum courant/peclet(z) ratio	0.002	39				
Maximum x/z aspect ratio	3.18	498				
Minimum x/z aspect ratio	0.0318	1193				
Time step mass balance						
Absolute error (Kg)	1.51D-12					
Percent error	0.000					
Cumulative mass balance						
Absolute error (Kg)	3.15D-07					
Percent error	0.000					
Boundary mass summary (Kg)						
surface watertable	lateral	source extract net				
Time step	-1.86D-04	-2.51D-05	-5.33D-27	0.00D+00	0.00D+00	-2.11D-04
Cumulative	-6.82D+00	-1.53D-01	-4.35D-24	1.67D+01	0.00D+00	9.69D+00
Stored mass summary (Kg)			net			
vapour	moisture	solids				
Time step	-3.83D-06	-3.32D-06	-2.04D-04		-2.11D-04	
Cumulative	1.86D-01	1.62D-01	9.34D+00		9.69D+00	
Time step vapourization flux (m^3/s)	0.00D+00					
Time step extraction flux (m^3/s)	0.00D+00					
Total ORTHOMIN flow iterations	1					
Total ORTHOMIN transport iterations	2					
Air-phase velocity range						
Minimum X velocity (m/s)	-1.27D-11	920				
Maximum X velocity (m/s)	1.76D-11	1079				
Minimum Z velocity (m/s)	-7.19D-12	514				
Maximum Z velocity (m/s)	3.95D-12	527				
1 Statistics: time = 184320.00 hours/7680.00 days (time step 15360)						

Transport accuracy/stability criteria						
Maximum peclet(x) number	0.000	1085				
Maximum peclet(z) number	0.127	514				
Maximum courant(x) number	0.000	1069				
Maximum courant(z) number	0.000	514				
Maximum courant/peclet(x) ratio	0.005	498				
Maximum courant/peclet(z) ratio	0.002	39				
Maximum x/z aspect ratio	3.18	336				
Minimum x/z aspect ratio	0.0318	1193				
Time step mass balance						
Absolute error (Kg)	1.14D-12					
Percent error	0.000					
Cumulative mass balance						
Absolute error (Kg)	3.17D-07					
Percent error	0.000					

Boundary mass summary (Kg)					
	surface watertable	lateral	source	extract	net
Time step	-1.68D-04	-2.78D-05	-2.17D-26	0.00D+00	0.00D+00 -1.96D-04
Cumulative	-7.05D+00	-1.86D-01	-1.96D-23	1.67D+01	0.00D+00 9.43D+00

Stored mass summary (Kg)					
	vapour	moisture	solids		net
Time step	-3.55D-06	-3.08D-06	-1.89D-04		-1.96D-04
Cumulative	1.82D-01	1.58D-01	9.09D+00		9.43D+00

Time step vapourization flux (m^3/s) 0.00D+00

Time step extraction flux (m^3/s) 0.00D+00

Total ORTHOMIN flow iterations	1
Total ORTHOMIN transport iterations	2

Air-phase velocity range

Minimum X velocity (m/s)	-1.20D-11	920
Maximum X velocity (m/s)	1.56D-11	1079
Minimum Z velocity (m/s)	-6.86D-12	514
Maximum Z velocity (m/s)	3.78D-12	527

1 Statistics: time = 199680.00 hours/8320.00 days (time step 16640)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	1085
Maximum peclet(z) number	0.127	432
Maximum courant(x) number	0.000	1069
Maximum courant(z) number	0.000	432
Maximum courant/peclet(x) ratio	0.005	498
Maximum courant/peclet(z) ratio	0.002	39
Maximum x/z aspect ratio	3.18	335
Minimum x/z aspect ratio	0.0318	1194

Time step mass balance

Absolute error (Kg)	8.80D-13
Percent error	0.000

Cumulative mass balance

Absolute error (Kg)	3.18D-07
Percent error	0.000

Boundary mass summary (Kg)

	surface watertable	lateral	source	extract	net
Time step	-1.53D-04	-3.04D-05	-7.69D-26	0.00D+00	0.00D+00 -1.83D-04
Cumulative	-7.25D+00	-2.24D-01	-7.64D-23	1.67D+01	0.00D+00 9.19D+00

Stored mass summary (Kg)

	vapour	moisture	solids		net
Time step	-3.33D-06	-2.89D-06	-1.77D-04		-1.83D-04
Cumulative	1.77D-01	1.54D-01	8.86D+00		9.19D+00

Time step vapourization flux (m^3/s) 0.00D+00

Time step extraction flux (m^3/s) 0.00D+00

Total ORTHOMIN flow iterations 1
Total ORTHOMIN transport iterations 2

Air-phase velocity range
Minimum X velocity (m/s) -1.14D-11 920
Maximum X velocity (m/s) 1.40D-11 1079
Minimum Z velocity (m/s) -6.55D-12 432
Maximum Z velocity (m/s) 3.61D-12 527

1 Statistics: time = 215040.00 hours/8960.00 days (time step 17920)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	45
Maximum peclet(z) number	0.127	432
Maximum courant(x) number	0.000	29
Maximum courant(z) number	0.000	432
Maximum courant/peclet(x) ratio	0.005	418
Maximum courant/peclet(z) ratio	0.002	39
Maximum x/z aspect ratio	3.18	255
Minimum x/z aspect ratio	0.0318	1193

Time step mass balance

Absolute error (Kg)	6.88D-13
Percent error	0.000

Cumulative mass balance

Absolute error (Kg)	3.19D-07
Percent error	0.000

Boundary mass summary (Kg)

	surface watertable	lateral	source	extract	net
Time step	-1.40D-04	-3.26D-05	-2.43D-25	0.00D+00	0.00D+00
Cumulative	-7.44D+00	-2.64D-01	-2.64D-22	1.67D+01	0.00D+00
					8.96D+00

Stored mass summary (Kg)

	vapour	moisture	solids	net
Time step	-3.14D-06	-2.73D-06	-1.67D-04	-1.73D-04
Cumulative	1.73D-01	1.50D-01	8.64D+00	8.96D+00

Time step vapourization flux (m^3/s) 0.00D+00

Time step extraction flux (m^3/s) 0.00D+00

Total ORTHOMIN flow iterations 1
Total ORTHOMIN transport iterations 2

Air-phase velocity range

Minimum X velocity (m/s)	-1.09D-11	920
Maximum X velocity (m/s)	1.25D-11	1079
Minimum Z velocity (m/s)	-6.33D-12	432
Maximum Z velocity (m/s)	3.43D-12	527

1 Statistics: time = 230400.00 hours/9600.00 days (time step 19200)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	45
Maximum peclet(z) number	0.127	432
Maximum courant(x) number	0.000	29
Maximum courant(z) number	0.000	432
Maximum courant/peclet(x) ratio	0.005	418
Maximum courant/peclet(z) ratio	0.002	39
Maximum x/z aspect ratio	3.18	253
Minimum x/z aspect ratio	0.0318	1193

Time step mass balance		
Absolute error (Kg)	5.45D-13	
Percent error	0.000	

Cumulative mass balance		
Absolute error (Kg)	3.20D-07	
Percent error	0.000	

Boundary mass summary (Kg)					
surface watertable	lateral	source	extract	net	
Time step -1.29D-04	-3.47D-05	-6.95D-25	0.00D+00	0.00D+00	-1.64D-04
Cumulative -7.61D+00	-3.07D-01	-8.22D-22	1.67D+01	0.00D+00	8.75D+00

Stored mass summary (Kg)					
vapour	moisture	solids			net
Time step -2.99D-06	-2.59D-06	-1.58D-04			-1.64D-04
Cumulative 1.69D-01	1.47D-01	8.43D+00			8.75D+00

Time step vapourization flux (m^3/s)	0.00D+00
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Time step extraction flux (m^3/s)	0.00D+00
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Total ORTHOMIN flow iterations	1
Total ORTHOMIN transport iterations	2

Air-phase velocity range		
Minimum X velocity (m/s)	-1.03D-11	920
Maximum X velocity (m/s)	1.24D-11	39
Minimum Z velocity (m/s)	-6.10D-12	432
Maximum Z velocity (m/s)	3.26D-12	527

1 Statistics: time = 245760.00 hours***** days (time step 20480)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	45
Maximum peclet(z) number	0.127	432
Maximum courant(x) number	0.000	29
Maximum courant(z) number	0.000	432
Maximum courant/peclet(x) ratio	0.005	418
Maximum courant/peclet(z) ratio	0.002	39
Maximum x/z aspect ratio	3.18	335
Minimum x/z aspect ratio	0.0318	1193

Time step mass balance		
Absolute error (Kg)	4.39D-13	
Percent error	0.000	

Cumulative mass balance

Absolute error (Kg)	3.21D-07
Percent error	0.000

Boundary mass summary (Kg)

	surface	watertable	lateral	source	extract	net
Time step	-1.19D-04	-3.65D-05	-1.83D-24	0.00D+00	0.00D+00	-1.56D-04
Cumulative	-7.77D+00	-3.53D-01	-2.34D-21	1.67D+01	0.00D+00	8.54D+00

Stored mass summary (Kg)

	vapour	moisture	solids			net
Time step	-2.85D-06	-2.47D-06	-1.50D-04			-1.56D-04
Cumulative	1.66D-01	1.44D-01	8.23D+00			8.54D+00

Time step vapourization flux (m^3/s)

0.00D+00

Time step extraction flux (m^3/s)

0.00D+00

Total ORTHOMIN flow iterations

1

Total ORTHOMIN transport iterations

2

Air-phase velocity range

Minimum X velocity (m/s)	-9.83D-12	920
Maximum X velocity (m/s)	1.23D-11	39
Minimum Z velocity (m/s)	-5.86D-12	432
Maximum Z velocity (m/s)	3.09D-12	527

1 Statistics: time = 261120.00 hours/******** days (time step 21760)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	45
Maximum peclet(z) number	0.127	432
Maximum courant(x) number	0.000	29
Maximum courant(z) number	0.000	432
Maximum courant/peclet(x) ratio	0.005	418
Maximum courant/peclet(z) ratio	0.002	39
Maximum x/z aspect ratio	3.18	257
Minimum x/z aspect ratio	0.0318	1194

Time step mass balance

Absolute error (Kg)	3.58D-13
Percent error	0.000

Cumulative mass balance

Absolute error (Kg)	3.21D-07
Percent error	0.000

Boundary mass summary (Kg)

	surface	watertable	lateral	source	extract	net
Time step	-1.11D-04	-3.81D-05	-4.45D-24	0.00D+00	0.00D+00	-1.49D-04
Cumulative	-7.92D+00	-4.01D-01	-6.15D-21	1.67D+01	0.00D+00	8.35D+00

Stored mass summary (Kg)

	vapour	moisture	solids			net
Time step	-2.74D-06	-2.37D-06	-1.44D-04			-1.49D-04
Cumulative	1.62D-01	1.41D-01	8.04D+00			8.35D+00

Time step vapourization flux (m^3/s)

0.00D+00

Time step extraction flux (m^3/s) 0.00D+00

Total ORTHOMIN flow iterations 1
Total ORTHOMIN transport iterations 2

Air-phase velocity range

Minimum X velocity (m/s)	-9.37D-12	920
Maximum X velocity (m/s)	1.22D-11	39
Minimum Z velocity (m/s)	-5.63D-12	432
Maximum Z velocity (m/s)	2.93D-12	527

*** Normal Exit ***

Final time step (hrs) 12.00
Final time (hours/days) 268800.00 11200.00
Total number time steps 22400

1.

cart ;coord - a2 format
 JALK - Passive transport from a residual source
 Full flow and transport - density, vapourization, infiltration
 01/31/01 Walther ;DATE,OPRATR - 2(2X,A8) format
 T F T ;IGGRD,ISTRTI,ISTRTO
 T T F T ;IVISC,IDIFFF,IPERM,ISDPL
 T T T F ;ISTOR,IVAP,IFLOW,ISTED
 T T ;IDENS,ITRAN
 F F T ;ITFF,ITFT,IITER
 T T F ;IMBAL,IACCI,IACC2
 F F F ;IPCON,IPPOT,IPVEL
 T T T F F ;IPCON,IFPOT,IFVEL,IFGRD,IPNOD
 F ;IPBIN
 0 ;NEOUT
 0 ;NNOUT
 1.000 ;THICK
 0.60 ;XMIN
 40 20 ;NHORE,NVETE
 6 1 ;III,JJJ
 9 15 22 28 36 40 ;IH(I),I=1,III
 20 ;IV(J),J=1,JJJ
 0.60 1.00 2.00 3.00 4.00 6.00 ;HOR(I),I=1,III
 1.07 ;VER(J),J=1,JJJ
 2 2 1 'zn'
 3 423 21 'sr'
 425 438 1 'sr'
 19 439 21 'sr'
 20 20 1 'zn'
 21 861 21 'gs'
 842 860 1 'zn'
 1 841 21 'wt'
 0 0 'end'
 0 0 0 0 ;JN1,JN2,JE,JNCOL,DIR
 0 0 0 0.00D-00 ;J1,J2,JN,TRANS
 1 22 1 40 1.21D-08 ;JN1,JN2,JE,JNCOL,SFLX
 8.20D-10 ;DWTR
 1.50D-05 1.80D-05 165.85 28.75 ;USOLV,UAIR,GMSOLV,GMAIR
 101.33 17.8 0.00D-00 ;PRESS,TEMP,COMP
 1 560 9.00D-13 9.00D-13 2.00 0.5000 0.5000 ;J1,J2,PKX,PKZ,EXPK,DISPL,DISPT
 0.28 0.07 0.090 1.42 0.0093 ;POR,RMC,SMC,BULK,FOC
 561 960 4.60D-13 4.60D-13 2.00 0.5000 0.5000 ;DAIRX,DAIRZ,HENRY,PKOC
 0.28 0.07 0.090 1.65 0.0093 ;POR,RMC,SMC,BULK,FOC
 7.40D-06 7.40D-06 0.546 364.00 ;DAIRX,DAIRZ,HENRY,PKOC
 961 1040 4.00D-17 4.00D-17 2.00 0.5000 0.5000 ;J1,J2,PKX,PKZ,EXPK,DISPL,DISPT
 0.28 0.07 0.090 1.49 0.0093 ;POR,RMC,SMC,BULK,FOC
 7.40D-06 7.40D-06 0.546 364.00 ;DAIRX,DAIRZ,HENRY,PKOC
 1041 1600 9.00D-13 9.00D-13 2.00 0.5000 0.5000 ;J1,J2,PKX,PKZ,EXPK,DISPL,DISPT
 0.28 0.07 0.090 1.52 0.0093 ;POR,RMC,SMC,BULK,FOC
 7.40D-06 7.40D-06 0.546 364.00 ;DAIRX,DAIRZ,HENRY,PKOC
 0 0 0 0.00 ;J1,J2,JN,RATE
 842 860 1 ;J1,J2,JN
 21 861 21
 0 0 0
 3 423 21 ;J1,J2,JN
 4 424 21
 5 425 21
 6 426 21
 7 427 21
 8 428 21
 9 429 21
 10 430 21
 11 431 21
 12 432 21
 13 433 21
 14 434 21
 15 435 21
 16 436 21
 17 437 21
 18 438 21

19	439	21			
21	861	21			
0	0	0			
0	0	0	0.00		;J1,J2,JN,UIN
3	423	21	4.910D-05		;J1,J2,JN,CIN
4	424	21	4.910D-05		
5	425	21	4.910D-05		
6	426	21	4.910D-05		
7	427	21	4.910D-05		
8	428	21	4.910D-05		
9	429	21	4.910D-05		
10	430	21	5.000D-04		
11	431	21	5.000D-04		
12	432	21	5.000D-04		
13	433	21	5.000D-04		
14	434	21	2.060D-04		
15	435	21	2.220D-03		
16	436	21	2.220D-03		
17	437	21	2.220D-03		
18	438	21	2.220D-03		
19	439	21	2.220D-03		
0	0	0	0.00		
			2.290D-03 16.50		;CMAX,SMASS
1	0.00D-05	1.00D-06	30 20 1.00D-09		;UCNVRG,CCNVRG,MITER,MDBLI,SCNVRG
0.00D-00	0.00D-00	1.00D-06			;ECNVRF,ACNVRF,RCNVRF
0.00D-00	0.00D-00	1.00D-06	5		;ECNVRT,ACNVRT,RCNVRT,NORTHHT
0.50	0.50				;TWFF,TWFT
1					;NSTEP
	12.00	268800.0	48.00 1280		;DT,FTIME,DTMAX,JPRT

***** V a p o u r T *****

Finite-element Vapour Transport Model
version 2.15
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Carl Mendoza

JALK - Passive transport from a residual source
Full flow and transport - density, vapourization, infiltration

Date: 01/31/01 jobid: jalk10xy Operator: Walther

Cartesian Coordinates

Minimum/maximum X coordinate 0.600 100.000
Minimum/maximum Z coordinate 0.000 21.400

Number of nodes 861
Number of elements 1600
Number of horizontal nodes 41
Number of vertical nodes 21
Domain thickness 1.00

Mass balance boundary
nodes 2 to 2 by 1 zn
nodes 3 to 423 by 21 sr
nodes 425 to 438 by 1 sr
nodes 19 to 439 by 21 sr
nodes 20 to 20 by 1 zn
nodes 21 to 861 by 21 gs
nodes 842 to 860 by 1 zn
nodes 1 to 841 by 21 wt
Number mass balance nodes 159

Top/Btm source definition

Non-zero Neumann boundary
Number non-zero Neumann elements 0

Infiltration definition
watertable elements 1 to 80 1.21D-08

Aqueous diffusion coefficient 8.20D-10

Gas viscosities (Pa*s) 1.50D-05 1.80D-05
Gram molecular weights 165.9 28.8
System pressure (Pa) 101.33D+03
System temperature (K) 290.8
System molar concentration 41.912
Reference freshair density 1.20
Fluid compressibility 9.87D-06

Physical properties - layer 1 - elements 1 to 560
Intrinsic permeabilities 9.00D-13 9.00D-13
Dispersivities 0.500 0.500
Porosity 0.280
Residual/soil moisture 0.070 0.090
Bulk density/foc 1.420 9.30D-03
Diffusion coefficients 7.40D-06 7.40D-06
Henry's Law constant 0.546
Koc 3.64D+02

Effective permeabilities	9.00D-13	9.00D-13
Gaseous diffusion coefficients	1.96D-06	1.96D-06
Aqueous diffusion coefficients	3.80D-11	3.80D-11
Air-filled porosity	0.190	
Water/soil retardation	0.868	46.337
Total retardation	48.204	
Physical properties - layer 2 - elements	561 to 960	
Intrinsic permeabilities	4.60D-13	4.60D-13
Dispersivities	0.500	0.500
Porosity	0.280	
Residual/soil moisture	0.070	0.090
Bulk density/foc	1.650	9.30D-03
Diffusion coefficients	7.40D-06	7.40D-06
Henry's Law constant	0.546	
Koc	3.64D+02	
Effective permeabilities	4.60D-13	4.60D-13
Gaseous diffusion coefficients	1.96D-06	1.96D-06
Aqueous diffusion coefficients	3.80D-11	3.80D-11
Air-filled porosity	0.190	
Water/soil retardation	0.868	53.842
Total retardation	55.710	
Physical properties - layer 3 - elements	961 to 1040	
Intrinsic permeabilities	4.00D-17	4.00D-17
Dispersivities	0.500	0.500
Porosity	0.280	
Residual/soil moisture	0.070	0.090
Bulk density/foc	1.490	9.30D-03
Diffusion coefficients	7.40D-06	7.40D-06
Henry's Law constant	0.546	
Koc	3.64D+02	
Effective permeabilities	4.00D-17	4.00D-17
Gaseous diffusion coefficients	1.96D-06	1.96D-06
Aqueous diffusion coefficients	3.80D-11	3.80D-11
Air-filled porosity	0.190	
Water/soil retardation	0.868	48.621
Total retardation	50.489	
Physical properties - layer 4 - elements	1041 to 1600	
Intrinsic permeabilities	9.00D-13	9.00D-13
Dispersivities	0.500	0.500
Porosity	0.280	
Residual/soil moisture	0.070	0.090
Bulk density/foc	1.520	9.30D-03
Diffusion coefficients	7.40D-06	7.40D-06
Henry's Law constant	0.546	
Koc	3.64D+02	
Effective permeabilities	9.00D-13	9.00D-13
Gaseous diffusion coefficients	1.96D-06	1.96D-06
Aqueous diffusion coefficients	3.80D-11	3.80D-11
Air-filled porosity	0.190	
Water/soil retardation	0.868	49.600
Total retardation	51.468	
Extraction well nodes		
Number of extraction nodes	0	
Total volumetric flux	0.00D+00	
Dirichlet potential nodes		
nodes 842 to 860 by 1		
nodes 21 to 861 by 21		
Dirichlet concentration nodes		
nodes 3 to 423 by 21		
nodes 4 to 424 by 21		
nodes 5 to 425 by 21		
nodes 6 to 426 by 21		
nodes 7 to 427 by 21		
nodes 8 to 428 by 21		
nodes 9 to 429 by 21		

nodes 10 to 430 by 21
nodes 11 to 431 by 21
nodes 12 to 432 by 21
nodes 13 to 433 by 21
nodes 14 to 434 by 21
nodes 15 to 435 by 21
nodes 16 to 436 by 21
nodes 17 to 437 by 21
nodes 18 to 438 by 21
nodes 19 to 439 by 21
nodes 21 to 861 by 21

Number of Dirichlet potential nodes 60
Potential degrees of freedom 801

Number of Dirichlet concentration nodes 398
Concentration degrees of freedom 463

Non-static initial pressures

Non-zero initial concentrations

nodes 3 to 423 by 21	0.000
nodes 4 to 424 by 21	0.000
nodes 5 to 425 by 21	0.000
nodes 6 to 426 by 21	0.000
nodes 7 to 427 by 21	0.000
nodes 8 to 428 by 21	0.000
nodes 9 to 429 by 21	0.000
nodes 10 to 430 by 21	0.001
nodes 11 to 431 by 21	0.001
nodes 12 to 432 by 21	0.001
nodes 13 to 433 by 21	0.001
nodes 14 to 434 by 21	0.000
nodes 15 to 435 by 21	0.002
nodes 16 to 436 by 21	0.002
nodes 17 to 437 by 21	0.002
nodes 18 to 438 by 21	0.002
nodes 19 to 439 by 21	0.002

Maximum concentration 0.002
Original source mass 16.50
Saturated relative vapour density 1.000

Source volume 3.66D+02

Number of calculated source nodes 357
Initial system mass (Kg) 2.24D-01

Potential convergence tolerance (m) 1.00D-05
Concentration convergence tolerance (%) 1.00D-06
Steady-state convergence tolerance (%/h) 1.00D-09
Maximum number double iterations 20

Iterative solver parameters (flow)

Residual convergence	0.00D+00
Absolute convergence	0.00D+00
Relative convergence	1.00D-06

Iterative solver parameters (transport)

Residual convergence	0.00D+00
Absolute convergence	0.00D+00
Relative convergence	1.00D-06
Number of orthogonalizations	5

Binary viscosity formula used

Vapourization flux included

Source allowed to deplete

Density-dependent flow included

Flow time weighting factor 0.50
Lumped flow storage formulation

Transport time weighting factor 0.50
Lumped transport storage formulation

Time step (hrs) 12.00

Number iterations first time step 2

Iterations stopped at step # 21 time 252.0 hours

1 Statistics: time = 15360.00 hours / 640.00 days (time step 1280)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	1081
Maximum peclet(z) number	0.127	1320
Maximum courant(x) number	0.000	1081
Maximum courant(z) number	0.000	518
Maximum courant/peclet(x) ratio	0.005	498
Maximum courant/peclet(z) ratio	0.002	43
Maximum x/z aspect ratio	3.18	1213
Minimum x/z aspect ratio	0.0318	1197

Time step mass balance

Absolute error (Kg)	-2.93D-06
Percent error	-29.989

Cumulative mass balance

Absolute error (Kg)	-3.74D-03
Percent error	-1.469

Boundary mass summary (Kg)

	surface watertable	lateral	source	extract	net
Time step	-2.51D-05	-4.55D-08	-2.03D-45	3.49D-05	0.00D+00
Cumulative	-2.42D-02	-2.54D-05	-1.28D-43	2.79D-01	0.00D+00
					9.76D-06
					2.55D-01

Stored mass summary (Kg)

	vapour	moisture	solids	net
Time step	1.32D-07	1.15D-07	6.59D-06	6.83D-06
Cumulative	4.84D-03	4.20D-03	2.42D-01	2.51D-01

Time step vapourization flux (m^3/s) 1.16D-10

Time step extraction flux (m^3/s) 0.00D+00

Total ORTHOMIN flow iterations 1
Total ORTHOMIN transport iterations 2

Air-phase velocity range

Minimum X velocity (m/s)	-1.76D-11	1561
Maximum X velocity (m/s)	2.02D-10	1081
Minimum Z velocity (m/s)	-1.03D-10	1320
Maximum Z velocity (m/s)	8.67D-11	1403

1 Statistics: time = 30720.00 hours/1280.00 days (time step 2560)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	1081
Maximum peclet(z) number	0.127	1400
Maximum courant(x) number	0.000	1081
Maximum courant(z) number	0.000	518
Maximum courant/peclet(x) ratio	0.005	498
Maximum courant/peclet(z) ratio	0.002	43
Maximum x/z aspect ratio	3.18	253
Minimum x/z aspect ratio	0.0318	1194

Time step mass balance

Absolute error (Kg)	-2.93D-06
Percent error	-42.701

Cumulative mass balance

Absolute error (Kg)	-7.49D-03
Percent error	-2.829

Boundary mass summary (Kg)

	surface watertable	lateral	source	extract	net
Time step	-2.61D-05	-6.78D-08	-1.47D-39	3.30D-05	0.00D+00
Cumulative	-5.72D-02	-1.01D-04	-1.85D-37	3.22D-01	2.65D-01

Stored mass summary (Kg)

	vapour	moisture	solids	net
Time step	7.56D-08	6.56D-08	3.79D-06	3.93D-06
Cumulative	4.96D-03	4.30D-03	2.48D-01	2.57D-01

Time step vapourization flux (m^3/s) 1.10D-10

Time step extraction flux (m^3/s) 0.00D+00

Total ORTHOMIN flow iterations 1
Total ORTHOMIN transport iterations 2

Air-phase velocity range

Minimum X velocity (m/s)	-1.58D-11	1041
Maximum X velocity (m/s)	1.86D-10	1081
Minimum Z velocity (m/s)	-9.54D-11	1400
Maximum Z velocity (m/s)	7.88D-11	1325

1 Statistics: time = 46080.00 hours/1920.00 days (time step 3840)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	1083
Maximum peclet(z) number	0.127	1400
Maximum courant(x) number	0.000	1083
Maximum courant(z) number	0.000	518
Maximum courant/peclet(x) ratio	0.005	498
Maximum courant/peclet(z) ratio	0.002	43
Maximum x/z aspect ratio	3.18	253
Minimum x/z aspect ratio	0.0318	1193

Time step mass balance
Absolute error (Kg) -2.94D-06
Percent error -49.292

Cumulative mass balance
Absolute error (Kg) -1.12D-02
Percent error -4.120

Boundary mass summary (Kg)
surface watertable lateral source extract net
Time step -2.64D-05 -7.56D-08 -3.64D-36 3.24D-05 0.00D+00 5.96D-06
Cumulative -9.08D-02 -1.93D-04 -6.94D-34 3.64D-01 0.00D+00 2.73D-01

Stored mass summary (Kg)
vapour moisture solids net
Time step 5.79D-08 5.02D-08 2.91D-06 3.02D-06
Cumulative 5.04D-03 4.37D-03 2.52D-01 2.62D-01

Time step vapourization flux (m^3/s) 1.08D-10

Time step extraction flux (m^3/s) 0.00D+00

Total ORTHOMIN flow iterations 1
Total ORTHOMIN transport iterations 2

Air-phase velocity range
Minimum X velocity (m/s) -1.58D-11 1041
Maximum X velocity (m/s) 1.79D-10 1083
Minimum Z velocity (m/s) -9.19D-11 1400
Maximum Z velocity (m/s) 7.41D-11 1325

1 Statistics: time = 61440.00 hours/2560.00 days (time step 5120)

Transport accuracy/stability criteria
Maximum peclet(x) number 0.000 1083
Maximum peclet(z) number 0.127 1400
Maximum courant(x) number 0.000 1083
Maximum courant(z) number 0.000 516
Maximum courant/peclet(x) ratio 0.005 498
Maximum courant/peclet(z) ratio 0.002 43
Maximum x/z aspect ratio 3.18 333
Minimum x/z aspect ratio 0.0318 1194

Time step mass balance
Absolute error (Kg) -2.94D-06
Percent error -54.190

Cumulative mass balance
Absolute error (Kg) -1.50D-02
Percent error -5.355

Boundary mass summary (Kg)
surface watertable lateral source extract net
Time step -2.65D-05 -7.93D-08 -8.61D-34 3.20D-05 0.00D+00 5.42D-06
Cumulative -1.25D-01 -2.92D-04 -2.22D-31 4.05D-01 0.00D+00 2.80D-01

Stored mass summary (Kg)
vapour moisture solids net

Time step	4.75D-08	4.12D-08	2.40D-06	2.48D-06
Cumulative	5.11D-03	4.43D-03	2.56D-01	2.65D-01

Time step vapourization flux (m^3/s) 1.07D-10

Time step extraction flux (m^3/s) 0.00D+00

Total ORTHOMIN flow iterations 1
Total ORTHOMIN transport iterations 2

Air-phase velocity range

Minimum X velocity (m/s)	-1.58D-11	1041
Maximum X velocity (m/s)	1.76D-10	1083
Minimum Z velocity (m/s)	-8.97D-11	1400
Maximum Z velocity (m/s)	7.06D-11	1325

1 Statistics: time = .76800.00 hours/3200.00 days (time step 6400)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	1083
Maximum peclet(z) number	0.127	1400
Maximum courant(x) number	0.000	1083
Maximum courant(z) number	0.000	523
Maximum courant/peclet(x) ratio	0.005	498
Maximum courant/peclet(z) ratio	0.002	45
Maximum x/z aspect ratio	3.18	253
Minimum x/z aspect ratio	0.0318	1197

Time step mass balance

Absolute error (Kg)	-2.94D-06
Percent error	-58.098

Cumulative mass balance

Absolute error (Kg)	-1.88D-02
Percent error	-6.541

Boundary mass summary (Kg)

	surface watertable	lateral	source	extract	net	
Time step	-2.67D-05	-8.20D-08	-5.62D-32	3.18D-05	0.00D+00	5.06D-06
Cumulative	-1.59D-01	-3.96D-04	-1.83D-29	4.46D-01	0.00D+00	2.87D-01

Stored mass summary (Kg)

	vapour	moisture	solids	net
Time step	4.06D-08	3.52D-08	2.05D-06	2.12D-06
Cumulative	5.17D-03	4.48D-03	2.59D-01	2.68D-01

Time step vapourization flux (m^3/s) 1.06D-10

Time step extraction flux (m^3/s) 0.00D+00

Total ORTHOMIN flow iterations 1
Total ORTHOMIN transport iterations 2

Air-phase velocity range

Minimum X velocity (m/s)	-1.58D-11	1041
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Maximum X velocity (m/s)	1.73D-10	1083
Minimum Z velocity (m/s)	-8.83D-11	1400
Maximum Z velocity (m/s)	6.80D-11	1325

1 Statistics: time = 92160.00 hours/3840.00 days (time step 7680)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	1083
Maximum peclet(z) number	0.127	1400
Maximum courant(x) number	0.000	1083
Maximum courant(z) number	0.000	523
Maximum courant/peclet(x) ratio	0.005	498
Maximum courant/peclet(z) ratio	0.002	45
Maximum x/z aspect ratio	3.18	253
Minimum x/z aspect ratio	0.0318	1195

Time step mass balance

Absolute error (Kg)	-2.94D-06
Percent error	-61.320

Cumulative mass balance

Absolute error (Kg)	-2.25D-02
Percent error	-7.685

Boundary mass summary (Kg)

surface watertable	lateral	source	extract	net
Time step -2.67D-05	-8.46D-08	-1.62D-30	3.16D-05	0.00D+00
Cumulative -1.93D-01	-5.02D-04	-6.44D-28	4.87D-01	0.00D+00
				4.80D-06
				2.93D-01

Stored mass summary (Kg)

vapour	moisture	solids	net
Time step 3.55D-08	3.08D-08	1.79D-06	1.86D-06
Cumulative 5.21D-03	4.52D-03	2.61D-01	2.71D-01

Time step vapourization flux (m^3/s) 1.05D-10

Time step extraction flux (m^3/s) 0.00D+00

Total ORTHOMIN flow iterations 1
Total ORTHOMIN transport iterations 2

Air-phase velocity range

Minimum X velocity (m/s)	-1.58D-11	1041
Maximum X velocity (m/s)	1.71D-10	1083
Minimum Z velocity (m/s)	-8.72D-11	1400
Maximum Z velocity (m/s)	6.62D-11	1325

1 Statistics: time = 107520.00 hours/4480.00 days (time step 8960)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	1085
Maximum peclet(z) number	0.127	1400
Maximum courant(x) number	0.000	1083
Maximum courant(z) number	0.000	523
Maximum courant/peclet(x) ratio	0.005	498
Maximum courant/peclet(z) ratio	0.002	47
Maximum x/z aspect ratio	3.18	253

Minimum x/z aspect ratio 0.0318 1194

Time step mass balance
Absolute error (Kg) -2.95D-06
Percent error -64.038

Cumulative mass balance
Absolute error (Kg) -2.63D-02
Percent error -8.790

Boundary mass summary (Kg)
surface watertable lateral source extract net
Time step -2.68D-05 -8.74D-08 -2.67D-29 3.15D-05 0.00D+00 4.60D-06
Cumulative -2.27D-01 -6.12D-04 -1.25D-26 5.27D-01 0.00D+00 2.99D-01

Stored mass summary (Kg)
vapour moisture solids net
Time step 3.17D-08 2.75D-08 1.60D-06 1.65D-06
Cumulative 5.26D-03 4.56D-03 2.63D-01 2.73D-01

Time step vapourization flux (m^3/s) 1.05D-10

Time step extraction flux (m^3/s) 0.00D+00

Total ORTHOMIN flow iterations 1
Total ORTHOMIN transport iterations 2

Air-phase velocity range
Minimum X velocity (m/s) -1.58D-11 1041
Maximum X velocity (m/s) 1.69D-10 1083
Minimum Z velocity (m/s) -8.65D-11 1400
Maximum Z velocity (m/s) 6.48D-11 1325

1 Statistics: time = 122880.00 hours/5120.00 days (time step 10240)

Transport accuracy/stability criteria
Maximum peclet(x) number 0.000 1085
Maximum peclet(z) number 0.127 1400
Maximum courant(x) number 0.000 1083
Maximum courant(z) number 0.000 523
Maximum courant/peclet(x) ratio 0.005 498
Maximum courant/peclet(z) ratio 0.002 47
Maximum x/z aspect ratio 3.18 338
Minimum x/z aspect ratio 0.0318 1193

Time step mass balance
Absolute error (Kg) -2.95D-06
Percent error -66.368

Cumulative mass balance
Absolute error (Kg) -3.01D-02
Percent error -9.861

Boundary mass summary (Kg)
surface watertable lateral source extract net
Time step -2.69D-05 -9.04D-08 -2.90D-28 3.14D-05 0.00D+00 4.44D-06
Cumulative -2.62D-01 -7.26D-04 -1.58D-25 5.67D-01 0.00D+00 3.05D-01

Stored mass summary (Kg)				net
	vapour	moisture	solids	
Time step	2.86D-08	2.48D-08	1.44D-06	1.49D-06
Cumulative	5.30D-03	4.59D-03	2.65D-01	2.75D-01

Time step vapourization flux (m^3/s) 1.05D-10

Time step extraction flux (m^3/s) 0.00D+00

Total ORTHOMIN flow iterations 1
Total ORTHOMIN transport iterations 2

Air-phase velocity range

Minimum X velocity (m/s)	-1.58D-11	1041
Maximum X velocity (m/s)	1.67D-10	1083
Minimum Z velocity (m/s)	-8.59D-11	1400
Maximum Z velocity (m/s)	6.38D-11	1325

1 Statistics: time = 138240.00 hours/5760.00 days (time step 11520)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	1085
Maximum peclet(z) number	0.127	1400
Maximum courant(x) number	0.000	1083
Maximum courant(z) number	0.000	523
Maximum courant/peclet(x) ratio	0.005	498
Maximum courant/peclet(z) ratio	0.002	47
Maximum x/z aspect ratio	3.18	256
Minimum x/z aspect ratio	0.0318	1194

Time step mass balance

Absolute error (Kg)	-2.95D-06
Percent error	-68.394

Cumulative mass balance

Absolute error (Kg)	-3.39D-02
Percent error	-10.898

Boundary mass summary (Kg)

	surface watertable	lateral	source	extract	net
Time step	-2.69D-05	-9.38D-08	-2.30D-27	3.13D-05	0.00D+00
Cumulative	-2.96D-01	-8.44D-04	-1.43D-24	6.07D-01	0.00D+00
					3.11D-01

Stored mass summary (Kg)

	vapour	moisture	solids	net
Time step	2.62D-08	2.27D-08	1.31D-06	1.36D-06
Cumulative	5.33D-03	4.62D-03	2.67D-01	2.77D-01

Time step vapourization flux (m^3/s) 1.04D-10

Time step extraction flux (m^3/s) 0.00D+00

Total ORTHOMIN flow iterations 1
Total ORTHOMIN transport iterations 2

Air-phase velocity range

Minimum X velocity (m/s)	-1.58D-11	1041
Maximum X velocity (m/s)	1.66D-10	1083
Minimum Z velocity (m/s)	-8.55D-11	1400
Maximum Z velocity (m/s)	6.30D-11	1325

1 Statistics: time = 153600.00 hours/6400.00 days (time step 12800)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	1085
Maximum peclet(z) number	0.127	1400
Maximum courant(x) number	0.000	1083
Maximum courant(z) number	0.000	523
Maximum courant/peclet(x) ratio	0.005	498
Maximum courant/peclet(z) ratio	0.002	47
Maximum x/z aspect ratio	3.18	1298
Minimum x/z aspect ratio	0.0318	1195

Time step mass balance

Absolute error (Kg)	-2.95D-06
Percent error	-70.177

Cumulative mass balance

Absolute error (Kg)	-3.76D-02
Percent error	-11.905

Boundary mass summary (Kg)

surface watertable	lateral	source	extract	net	
Time step -2.69D-05	-9.75D-08	-1.43D-26	3.13D-05	0.00D+00	4.21D-06
Cumulative -3.30D-01	-9.66D-04	-9.98D-24	6.47D-01	0.00D+00	3.16D-01

Stored mass summary (Kg)

vapour	moisture	solids	net
Time step 2.41D-08	2.09D-08	1.21D-06	1.25D-06
Cumulative 5.36D-03	4.65D-03	2.68D-01	2.78D-01

Time step vapourization flux (m^3/s) 1.04D-10

Time step extraction flux (m^3/s) 0.00D+00

Total ORTHOMIN flow iterations

1

Total ORTHOMIN transport iterations

2

Air-phase velocity range

Minimum X velocity (m/s)	-1.58D-11	1041
Maximum X velocity (m/s)	1.65D-10	1083
Minimum Z velocity (m/s)	-8.51D-11	1400
Maximum Z velocity (m/s)	6.24D-11	1325

1 Statistics: time = 168960.00 hours/7040.00 days (time step 14080)

Transport accuracy/stability criteria

Maximum peclet(x) number	0.000	1085
Maximum peclet(z) number	0.127	1400
Maximum courant(x) number	0.000	1083
Maximum courant(z) number	0.000	523

Maximum courant/peclet(x) ratio	0.005	498
Maximum courant/peclet(z) ratio	0.002	47
Maximum x/z aspect ratio	3.18	734
Minimum x/z aspect ratio	0.0318	1193

Time step mass balance
Absolute error (Kg) -2.95D-06
Percent error -71.762

Cumulative mass balance
Absolute error (Kg) -4.14D-02
Percent error -12.884

Boundary mass summary (Kg)

	surface	watertable	lateral	source	extract	net
TIME step	-2.70D-05	1.01D-07	-7.23D-26	3.12D-05	0.00D+00	4.12D-06
Cumulative	-3.65D-01	-1.09D-03	-5.64D-23	6.87D-01	0.00D+00	3.21D-01

Stored mass summary (Kg)

	vapour	moisture	solids	net
Time step	2.24D-08	1.94D-08	1.12D-06	1.16D-06
Cumulative	5.39D-03	4.68D-03	2.70D-01	2.80D-01

Time step vapourization flux (m^3/s) 1.04D-10

Time step extraction flux (m^3/s) 0.00D+00

Total ORTHOMIN flow iterations 1
Total ORTHOMIN transport iterations 2

Air-phase velocity range
Minimum X velocity (m/s) -1.58D-11 1041
Maximum X velocity (m/s) 1.64D-10 1083
Minimum Z velocity (m/s) -8.48D-11 1400
Maximum Z velocity (m/s) 6.20D-11 1325

Steady-state achieved
Maximum hourly change (% molar) 9.00D-10

*** Normal Exit ***

Final time step (hrs) 12.00
Final time (hours/days) 168960.00 7040.00
Total number time steps 14080